OLIN
HE
554
B35
A5
1916

UNIVERSITY LIBRARIES
OHN M.
LIBRAR
ITHACA, N.

Cornell University Library

The original of this book is in
the Cornell University Library.

There are no known copyright restrictions in
the United States on the use of the text.

http://www.archive.org/details/cu31924030111151

Cornell University Library
HE554.B35 A5 1916
Report on a proposed marine terminal and
3 1924 030 111 151
olin

REPORT

ON A

Proposed Marine Terminal and Industrial City

on New York Bay
at Bayonne, N. J.

Prepared under the direction of

The New Jersey State Board of Commerce and Navigation

in accordance with
the resolution of May 9th, 1916
adopted bv the

Board of Commissioners of the City of Bayonne

November, 1916

B. F. CRESSON, JR., Supervising Engineer
F. VAN Z. LANE, Executive Engineer

ALLIED PRINTING TRADES UNION LABEL COUNCIL HUDSON COUNTY 101

5

CORNELL UNIVERSITY LIBRARIES
★ ITHACA N.Y. ★

HE
554
B35
A5
1916

A.368506

STATE OF NEW JERSEY,
BOARD OF COMMERCE AND NAVIGATION,
TRENTON, N. J.

November 10, 1916.

Board of Commissioners of the City of Bayonne,
Bayonne, N. J.

Gentlemen:—

In accordance with your resolution adopted May 9th, 1916, we have the honor to submit herewith an engineering report, including estimates for Primary Installation of a Proposed Marine Terminal and Industrial City on New York Bay at Bayonne, New Jersey, prepared under the immediate direction of B. F. Cresson, Jr., Chief Engineer of this Board, and F. Van Z. Lane, Engineer and Secretary of the Chamber of Commerce of Bayonne.

Respectfully yours,

NEW JERSEY STATE BOARD OF COMMERCE
AND NAVIGATION,

By

J. Spencer Smith

President.

TABLE OF CONTENTS.

Page
Letter of Transmittal 3
Foreword 6
Authorization of Resolution 7
Synopsis of Report 8

TEXT OF REPORT.

Character of Development 13
Preliminary Lay-Out and Cartoon 15
Harbor Lines, Dredging, Etc., by Federal Government 17
Site Selected 19
Acquisition of Site 21
Engineering Organization 22
Subsurface Investigation and Determination 23
Bulkhead, Pier and Platform Construction (Locally in Use) 29
Materials for Bulkhead and Pier Construction (Locally in Use) 45
Bulkhead and Bulkhead Platform Recommended 50
Policies, Practices and Construction in Other Cities 53
Comparative Advantageous Location of Bayonne 63
Necessary Facilities 64
Railroad Facilities 64
Bulkhead Sheds 68
Storage Sheds 69
Ferry to Manhattan for Vehicles and Passengers 72
Prospects for the Success of a Bayonne Terminal 82
Control of Waterfront and Improvements 94
Primary Installation No. 1 (Description) 98
" " " 1 (Estimates of Cost) 99
" " " 2 (Description) 101
" " " 2 (Estimates of Cost) 102
" " " 3 (Description) 104
" " " 3 (Estimates of Cost) 105
" " " 4 (Description) 107
" " " 4 (Estimates of Cost) 108
" " " 5 (Description) 110
" " " 5 (Estimates of Cost) 112
Conclusions and Recommendations 113

ILLUSTRATIONS.

Photograph of Cartoon 16
Views of Site Selected 20

MAPS AND DRAWINGS (Submitted).

Key Map Showing Location of Local Docks, Typical Construction of Which Are Shown in Detail on Drawings 1 to 8.......... 30
Bush Company's Dock at South Brooklyn—Typical Construction 31
Pennsylvania R. R. Dock at Greenville, " " 33
New York City Dock at South Brooklyn, " " 34
New York City Dock at South Brooklyn, " " 35
Standard Oil Co.'s Dock at Constable Hook " " 36
Central R. R. Dock at Communipaw " " 38
Lehigh Valley R. R. Dock at Constable Hook " " 39
City of Newark's Dock at Newark Bay " " 42
Location of Site and General Ownership Thereof 18
Type of Bulkhead Construction Recommended 49
Cross Section of Type of Three Story Storage Shed Recommended 71

Opposite Page

Primary Installation No. 1.................................. 98
" " " 2 101
" " " 3 104
" " " 4 107
" " " 5 110
Map Showing Location of Proposed Terminal and Its Railroad Connections 65
General Lay-Out of Proposed Terminal 15

Maps and cross-sections have been prepared showing depth of water and the formation of the underlying material from which the estimates for dredging and reclamation have been prepared.

Three studies have been prepared showing detail lay-outs of railroad yards and transfer bridges with facilities for assemblying and classifying freight for through service and local delivery.

FOREWORD

It is no secret that the upper New York Bay frontage at Bayonne has long been regarded by many whose judgment in these matters is unquestioned, as possessing possibilities for co-ordinating docking and railroad facilities into a great industrial development second to none at the Port of New York.

The New Jersey Harbor Commission made tentative plans for its development and published them in two of its reports. One of the great terminal companies located in Brooklyn had options on a large part of it at one time; a syndicate representing foreign capital is known to have had engineers working on plans for its improvement; more recently the Chamber of Commerce of the City of Bayonne has furthered legislation and initiated proceedings looking to its development; and these are not all.

The principle obstacle seems to have been the difficulty of assembling enough of the property under one ownership to make a development that would be economically operative.

The development should be of sufficient size and capacity and should cover sufficient area to provide all the necessary facilities not only for docking ships but also for storing and fabricating commodities and should have direct railroad connections, ferries to Manhattan, etc., to make it a complete unit.

For such a development to be undertaken by Bayonne or under its patronage would be the ideal arrangement and it would be a step in this country toward the practice that has made so successful the great ports and cities of Europe, notably London, Liverpool, Antwerp, Hamburg and Rotterdam. There, harbor and terminal facilities are publicly owned and operated for the benefit of the communities. It would be a step in advance of anything existing in the United States.

AUTHORIZATION FOR A COMPREHENSIVE INVESTIGATION OF THIS SITUATION.

The following resolution was adopted at a meeting of the Board of City Commissioners of the City of Bayonne, New Jersey, at a meeting held May 9th, 1916.

WHEREAS, There is now under consideration the development of the New York Bay frontage of the City of Bayonne, in which this city is vitally interested; and

WHEREAS, The Board of Commerce and Navigation of the State of New Jersey, in conjunction with the United States Harbor Line Board, have control over the establishment of bulkhead and pierhead lines and the improvement of the channels necessary to the commercial use of said property; and

WHEREAS, This City desires to have the active co-operation of the said Board of Commerce and Navigation, in securing for this City the necessary action by, and assistance of, the United States authorities in the establishment of such harbor lines, and the dredging of channels to said property.

BE IT RESOLVED, That this Board of Commissioners of the City of Bayonne request the said Board of Commerce and Navigation to use its best offices to secure for the City of Bayonne, an adequate channel to the New York Bay riparian property, lying south of the Jersey City line, and also to aid and advise this commission in securing for the City adequate dock, warehouse and shipping facilities in this territory and for the purpose of meeting any proper expense in connection with such assistance, this Board has agreed to make an appropriation of sufficient money not exceeding Five thousand dollars, to pay for engineering and to other services which said Board of Commerce and Navigation may deem necessary to incur.

SYNOPSIS WITH GENERAL ESTIMATES OF PRIMARY INSTALLATIONS.

Bayonne is a peninsula, surrounded on three sides by deep water, in the center of the Port of New York—the greatest port in the world in the volume of its commerce.

Bayonne also actually connects with the mainland at a point where the largest number of important railroads have their terminals.

This combination presents advantages for industrial development unequaled in the world because of the possibility of co-ordinating the essential facilities in the greatest of markets.

Realizing this, the Bayonne Chamber of Commerce fathered successfully, enabling legislation paving the way, for the establishment of facilities that would result in a great industrial development in Bayonne.

Following the paassage of this legislation during the winter of 1916, conferences were held between the Bayonne Chamber of Commerce, the City Commissioners of Bayonne, the New Jersey State Board of Commerce and Navigation and Mr. Irving T. Bush, President of the Bush Terminal Company.

As a result of these conferences the Commissioners of the City of Bayonne on May 9th, 1916, adopted a resolution requesting the Board of Commerce and Navigation to use its best offices to secure adequate channels and proper harbor lines for the City of Bayonne, and to aid and advise the Commission in securing for the City adequate dock, warehouse, industrial and shipping facilities in that territory and appropriating a sum of money not to exceed five thousand dollars ($5,000), to pay for engineering and other services which the Board deemed necessary to incur.

The site selected for consideration is on the Upper New York Bay frontage of Bayonne and extends from a point between East 35th Street and East 36th Street to East 46th Street, and from the National Docks Railroad to the Pierhead Line, comprising about 420 acres of which approximately 400 are under water. This site is large enough for a comprehensive Marine and Industrial Terminal Development. It is in an entirely undeveloped state. Most of it is owned by the State of New Jersey. It is bounded on one side by a railroad having direct connection with practically every railroad of importance terminating in the Port of New York. Practically all of the water-borne commerce of the Port passes in front of it. And it is close to Manhattan.

After careful study it was decided that the most advantageous kind of development that could be placed on this site should be essentially an industrial one. A preliminary layout with this in mind was planned and a cartoon made of it. Working quarters were then obtained and fitted up in the Bayonne City Park Building and an experienced engineering force organized, capable of expeditiously and expertly developing these preliminary plans.

In order that dredging, reclamation and bulkhead costs could be estimated, information was gathered from every available source relative to the character of the land under water in the locality in question and types of bulkhead construction in use in this locality. It was concluded from this comprehensive and detailed investigation, that directly below the water is a mud blanket 10 feet thick; that immediately underlying the mud is a sand formation about 18 feet in thickness; that underlying this is a material that has been designated as "cemented triassic formation," which extends to rock, about 60 feet below mean low water.

Inquiry was also made as to the practices, policies, expenditures, and efforts being made in connection with water front development in other cities. This clearly shows that Bayonne especially, in view of the superior location of the site in question, should lose no time in developing this waterfront and keeping control of it.

Careful investigation shows that industrial and shipping facilities are in great demand in the Port of New York. And that such facilities are eagerly taken up at high rentals in locations far less superior than is the site selected for this Bayonne Terminal and that such demands will probably grow and continue.

The facilities essential to an Industrial Marine Development at this location were carefully considered and it was found that in any primary development and installation it would be desirable to have a full equipment of railroad facilities, bulkhead and storage sheds and ferry facilities for transportation to and from Manhattan of both vehicles and passengers. It was concluded that the greatest advantage cannot be taken of the site selected and that the most desirable kind of development will not result unless these facilities are included.

Because of the importance of and the exceeding difficulty in determining on the extent of any initial development, a great deal of study, investigating, detailing, planning and estimating was given to this phase of the work. As a result, the plans and estimates of cost of no less than five primary installations are presented. The estimated total cost and the facilities included in each of these five installations are as follows:

Primary Installation No. 1 provides for:
- Reclamation of 228 acres,
- Docking facilities for about 4 ships,
- Ferry terminal,
- Railroad transfer bridges,
- Railroad yards,
- Freight houses, with
- Paving to the facilities provided.

Total cost, $3,089,285.58.

Primary Installation No. 2 provides for:
- Reclamation of 258 acres,
- Docking facilities for about 25 ships,
- Ferry terminal,
- Railroad transfer bridges,
- Railroad yards,
- Freight houses,
- Paving to the facilities provided; and
- Trolley to ferry terminal.

Total cost, $6,867,187.85.

Primary Installation No. 3 provides for:
- Reclamation of 287 acres,
- Docking facilities for about 30 ships,
- Ferry terminal,
- Railroad transfer bridges,
- Railroad yards,
- Freight houses,
- Paving to the facilities provided, and
- Trolley to ferry terminal.

Total cost, $8,319,194.97.

Primary Installation No. 4 provides for:
Reclamation of 264 acres,
Docking facilities for about 25 ships,
Ferry terminal;
Railroad transfer bridges,
Railroad yards,
Freight houses,
Paving to the facilities provided, and
Trolley to ferry terminal.
Total cost, $5,242,529.89.

Primary Installation No. 5 provides for:
Reclamation of 311 acres,
Docking facilities for about 30 ships,
Ferry terminal,
Railroad transfer bridges,
Railroad yards,
Freight houses,
Paving to the facilities provided, and
Trolley to ferry terminal.
Total cost, $7,234,545.98.

All of the above estimates provide for the interest on the cost during construction and provide for 35 feet depth of water.

By separating these estimates into dredging and reclamation and other facilities the following figures would result.

Primary Installation No. 1:	
Dredging, bulkheading and reclamation,	$1,741,490.92
Other facilities,	1,347,794.66
Total,	$3,089,285.58
Primary Installation No. 2:	
Dredging, bulkheading and reclamation,	$2,150,137.05
Other facilities,	4,717,050.80
Total,	$6,867,187.85
Primary Installation No. 3:	
Dredging, bulkheading and reclamation,	$2,257,162.53
Other facilities,	6,062,032.44
Total,	$8,319,194.97

Primary Installation No. 4:	
Dredging, bulkheading and reclamation,	$2,055,320.03
Other facilities,	3,187,209.86
Total,	$5,242,529.89
Primary Installation No. 5:	
Dredging, bulkheading and reclamation,	$2,121,673.44
Other facilities,	5,112,872.54
Total,	$7,234,545.98

Some hesitancy is felt in making a direct recommendation as to the form of Primary Installation which should be adopted. It may be argued that this is a proper duty of the Engineers in preparing and submitting this report. Therefore, taking all things into consideration, we are of the opinion that the Terminal will develop best and quickest and bring the earliest benefits to the locality by constructing in the first instance, the plan known as Primary Installation No. 5.

Primary Installation No. 5 comprises features which are believed to be superior to those included in the other Primary Installations, and is rather a conclusion resulting from the development of the first four. It brings the easterly end of the development to the Pierhead Line establishd by the Federal Government, and is as close as seems desirable to the present main channel in the Upper Bay.

This Primary Installation will create 20,300 lineal feet of deep water frontage against which vessels can dock, where there now exists less than 2,800 lineal feet of undeveloped frontage which can now be reached with difficulty by boats drawing one foot of water.

Bayonne, N. J., November 10, 1916.

To the Board of Commissioners,
Bayonne, New Jersey.

Gentlemen:—

The investigation, studies, plans and estimates for the development of the New York Bay frontage of the City of Bayonne have progressed to a point where it seems desirable to make a report in order to enable your Honorable Board to have a definite understanding as to the character of the development that seems most desirable to be undertaken, as to physical conditions to be met, as to the Primary Installation which seems desirable, and as to the cost thereof.

Authorization for Investigation.

Following a resolution adopted May 9th, 1916, by your Board, and which is given in full on a preceeding page, addressed to the New Jersey State Board of Commerce and Navigation asking assistance in the establishment of harbor lines, and in the undertaking of dredging by the federal government, and also aid and advice of that Board in securing for the City adequate docking, warehousing, shipping and industrial facilities in Bayonne, a study was immediately begun as to the most desirable kind of development to recommend.

Character of Development.

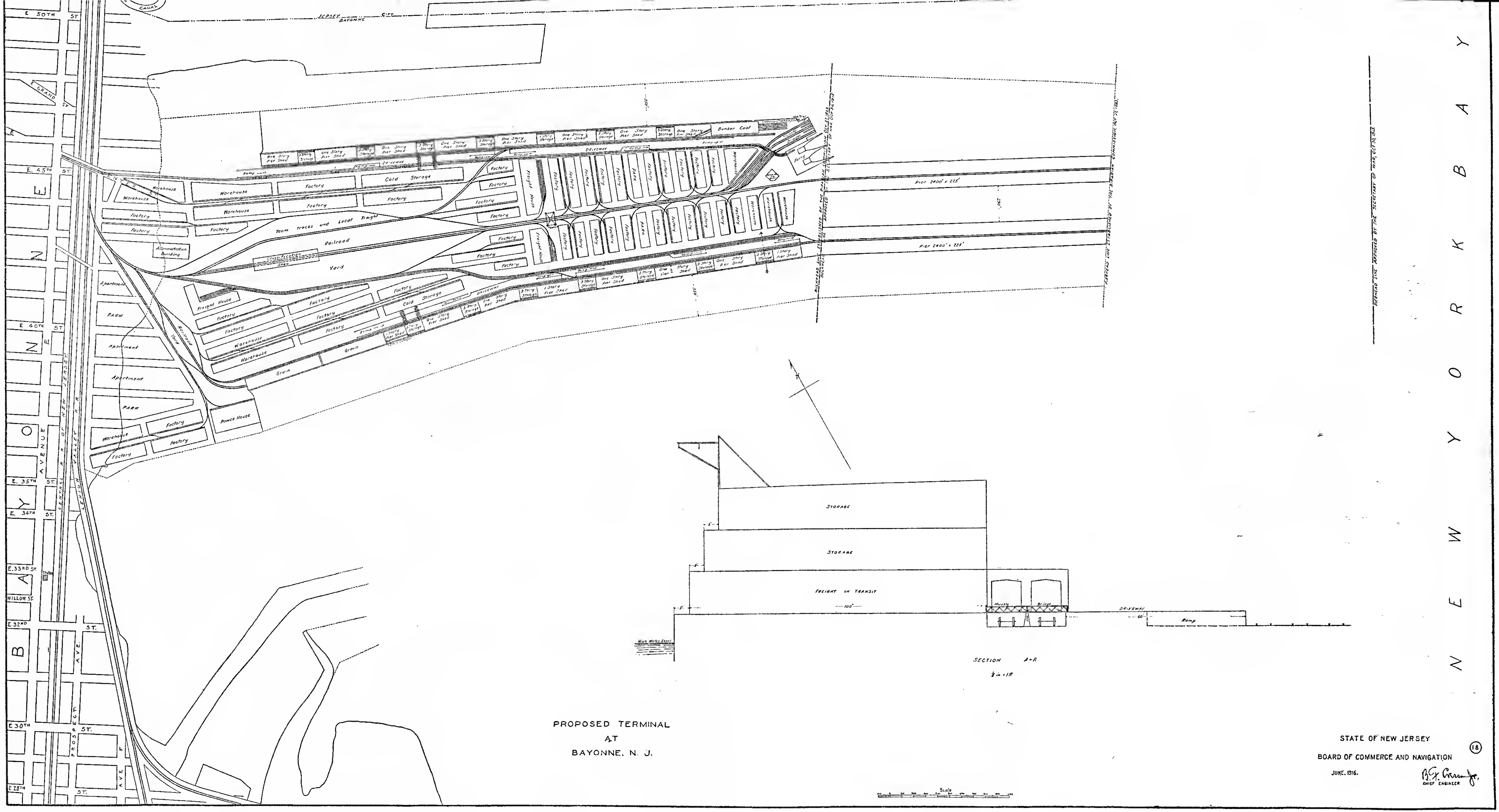
In view of the fact that the New York Bay shore of Bayonne fronts directly on that part of New York Harbor which is passed by a very great percentage of the commerce of the Port of New York, and because immediately behind this shore front and within a few feet of it there is a railroad having direct connections with practically all of the trunk line railroads terminating in the Port of New York, and because there proved to be a large enough undeveloped area between this connecting railroad and the established harbor lines, and further because it would be very much to the advantage of the whole of Bayonne to have this water front developed in such a manner that manufacturing would be attracted there, we have concluded that the best kind of development to place on the New York Bay shore of Bayonne should take the form of a combination of a marine terminal, a railroad terminal and industrial building facilities similar in scope and purpose to the Bush Terminal in South Brooklyn, New York.

We considered that it would be more desirable for Bayonne to undertake and negotiate the kind of development that will attract and afford facilities for manufacturers as well as for the trans-shipment of freight, because a development that contemplates the trans-shipment of freight alone will not bring to Bayonne the kind of business that will materially add to its industrial, commercial, financial and business growth.

A development merely affording dockage and railroad facilities will attract very little new business and comparatively few employees compared with a terminal affording industrial facilities as well. To substantiate this we need only refer to the proposed development of the Lehigh Valley Railroad on the New York Bay shore of Jersey City. This railroad proposes to construct a railroad yard at that point with docks so that the direct trans-shipment of freight can take place. This development is to comprise five hundred acres, and no industrial facilities, as far as we have been able to learn, are to be provided there. It has been estimated that this development will provide employment for approximately 6,000 people at most. The Bush Terminal, on the other hand, which affords industrial and manufacturing facilities of all kinds, as well as facilities for the direct trans-shipment of freight, and which covers an area of only 200 acres, provides employment for at least 28,000 people, 25,000 of whom are employed by the nearly 300 tenants located in the factory buildings there, and 3,000 only by the Bush Terminal Company itself, most of whom are employed in the handling of freight. A manufacturing industry is of much greater advantage to Bayonne than a line of steamers or a railroad yard. A manufacturing plant of any importance will give employment to several hundred people, six days a week; whereas the number of people employed in a purely water front and railroad development would be irregular and very much smaller.

That Bayonne is essentially an industrial city is conclusively shown by the fact that out of a population of about 70,000 people, there are approximately 15,000 wage earners; this is a very high percentage, especially when it is considered that Bayonne is very close to New York and that it is served by a railroad affording a very good commuting service.

It would seem desirable, therefore, from every standpoint that any development made on the New York Bay shore of Bayonne should be primarily an industrial one. For then not only will it attract industries to this particular location in Bayonne, but



PROPOSED TERMINAL
AT
BAYONNE, N. J.

STATE OF NEW JERSEY
BOARD OF COMMERCE AND NAVIGATION
JUNE, 1916.

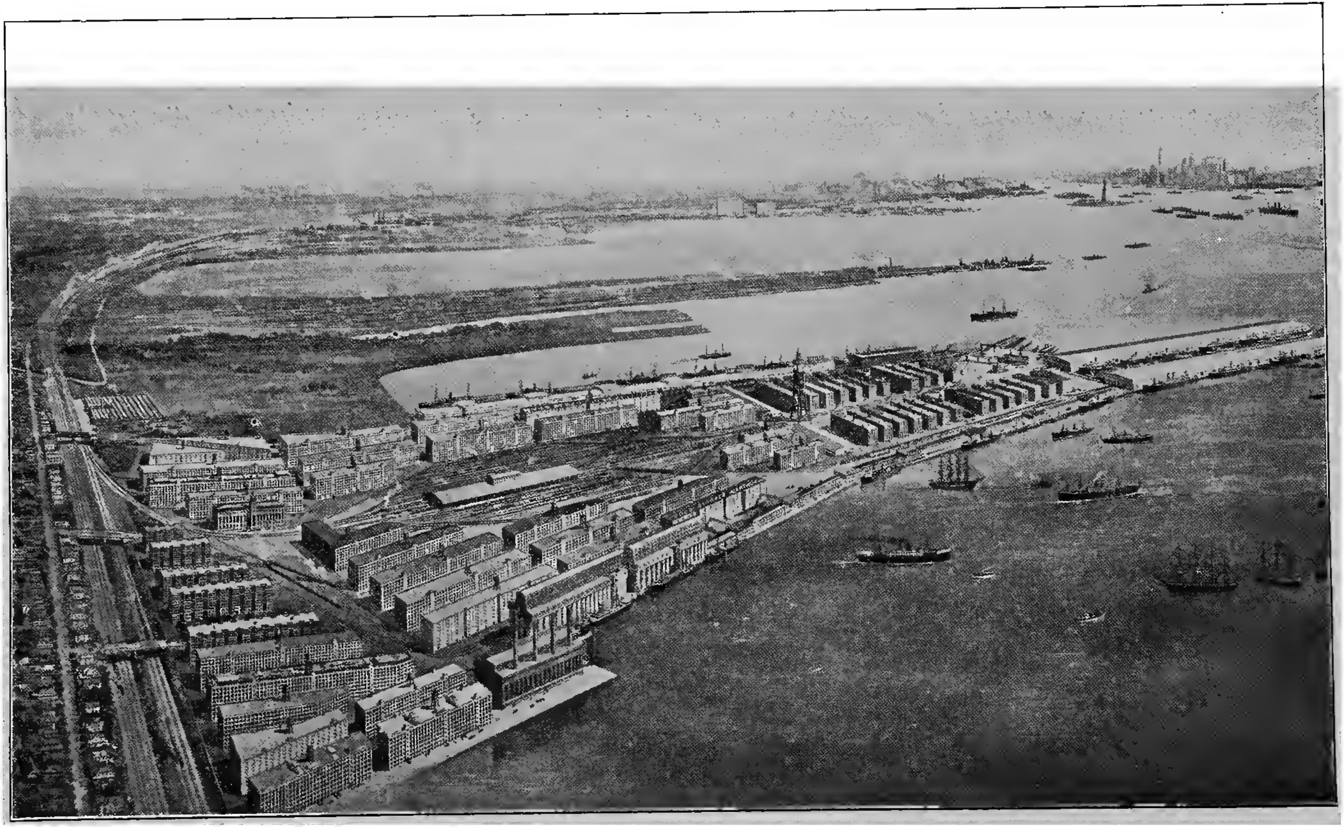
B. F. Cresson Jr.
CHIEF ENGINEER

⑱

also by creating the facilities necessary to attract industries to that point it will be of great benefit to those industries already located in Bayonne and to the other undeveloped sections of the city. Having determined on this kind of development, our studies, therefore, have been with the idea of providing essentially an industrial development in this section of Bayonne.

Preliminary Lay-Out and Cartoon.

For the purposes of discussion and consideration, therefore, a general lay-out plan of development along these lines, which is drawing No. 18 accompanying this report, was prepared by the Chief Engineer of the New Jersey State Board of Commerce and Navigation, after conferences with your Honorable Board, the Chamber of Commerce of Bayonne, and Mr. Irving T. Bush, President of the Bush Terminal Company. This plan shows the reclamation of about 228 acres of lands now under water, the dredging of channels, the construction of bulkhead platforms, pier sheds, buildings for storage of freight in transit, general storage and warehouse buildings, cold storage warehouses, factory buildings, grain elevators, a coaling plant, a power house, ferry structures, transfer bridges, administration buildings, apartment houses and freight stations with a great railroad yard for the assembling and classifying of freight. On the authorization of your Honorable Board a birdseye view cartoon of the proposed terminal was made which has been framed and herewith submitted. This cartoon, a photograph of which is shown on the following page, has had wide circulation, has been published freely througout the country in newspapers, magazines and scientific publications, and has already done much to attract the attention of the country to what is proposed to be done at Bayonne.



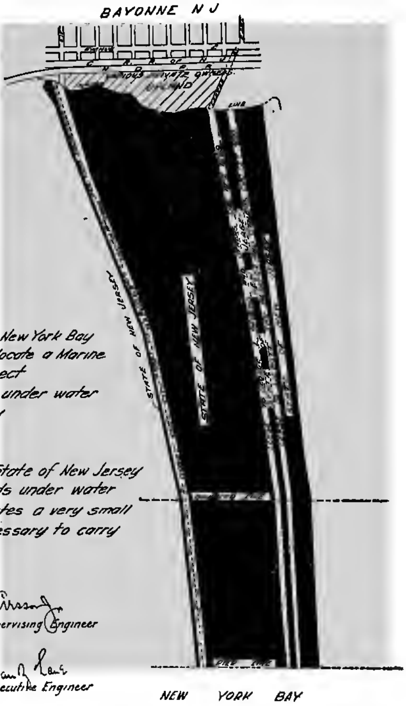
Photograph of Cartoon of Proposed Terminal.

Harbor Lines, Dredging, Etc., By Federal Government.

At the locality under consideration, the pierhead line adopted by the Federal Government is about 10,200 feet outshore from the present low water line, and the 40-foot contour of the main channel is about 13,200 feet outshore from the existing low water line; for 12,000 feet outshore from the present low water line there is a gradual slope in the bottom giving a depth at the outshore point of 10 feet below mean low water. The bulkhead line adopted by the Federal Government is about 5,600 feet outshore from the low water mark. The bulkhead line adopted by the State of New Jersey corresponds at this point with the bulkhead line adopted by the Federal Government, but the pierhead line adopted by the State is 2,400 feet outshore of the bulkhead line and about 2,200 feet inshore of the United States pierhead line. It can be seen, therefore, that the channel is about 3,000 feet outshore of the Government pierhead line and 5,200 feet outshore of the Government pierhead line adopted by the State of New Jersey.

In an improvement so important as the one contemplated, especially where the municipality proposes to own at least the property on which the improvement is to be placed it is reasonable that the government should undertake the dredging to connect the improvement with deep water. The government will not dredge inshore of its pierhead line, and when the general outline plan of the proposed terminal is decided on then a modification in the pierhead line established by the federal government should be asked for, if it is necessary to have it changed so that it corresponds with the outshore limits of the proposed improvement. In other words, if the terminal is to extend out to the existing pierhead line, then no modification is needed in this line, but, if the terminal shall stop inshore of this line, then it should be modified so that the government can dredge to the pierhead line and make the improvement accessible to the government channels.

The pierhead line established by the Federal Government in the locality under consideration does not constitute a blanket permit to build pier structures out to it as in most other parts of the harbor. This is shown by the following note which appears on the map of this locality, prepared by the New York Harbor Line Board, July,



Map Showing Ownership of land on New York Bay Bayonne on which it is proposed to locate a Marine Terminal and Industrial City project

Solid Black indicates lands under water owned by the State of New Jersey

Hatching indicates upland

NOTE. It should be noted that the State of New Jersey owns practically all of the lands under water and that the upland constitutes a very small proportion of the total land necessary to carry out this project

B. F. Cresson Jr
Supervising Engineer

F. Van Z. Lane
Executive Engineer

November 1916

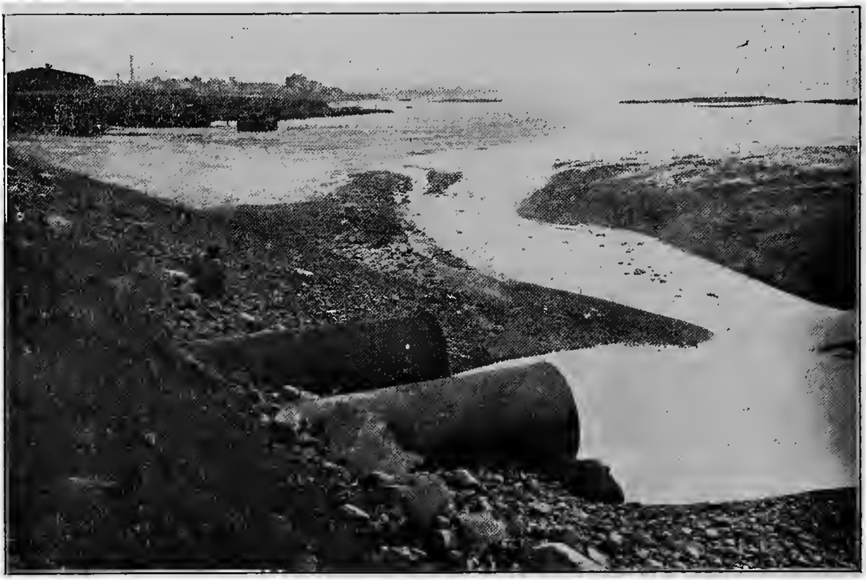
⑨

1915: "No structures shall be built over the water space between the pierhead and bulkhead lines until after the plans have been approved by the Secretary of War."

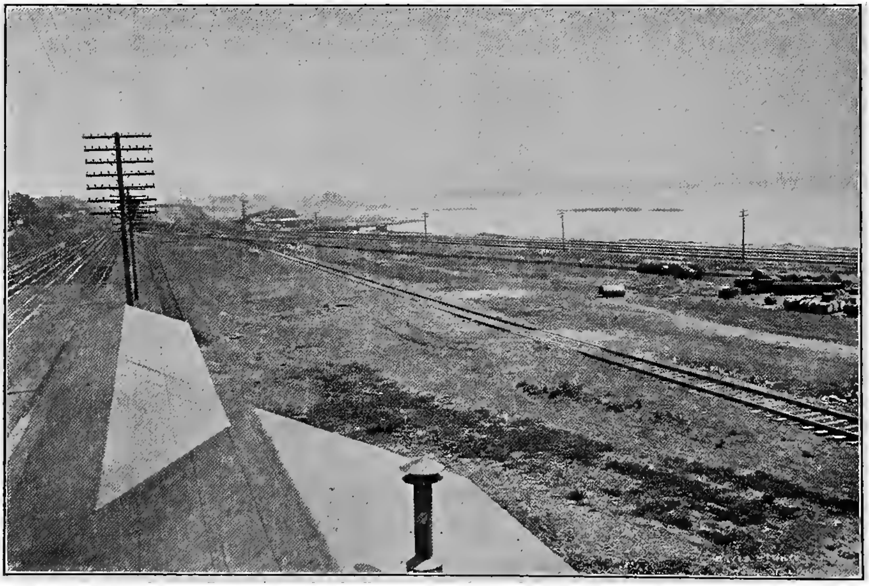
Site Selected.

Careful consideration was given to the most available property on which to locate this improvement and it was found that the property lying between the grant to the American Radiator Company on the north and the grant to the Central Railroad of New Jersey on the south was practically the only site on New York Bay of sufficient size suitable for the kind of development decided on. Drawing No. 9 showing the location and ownership of this property accompanies this report, reference to which will show that it extends from a point between East 35th Street and East 36th Street to about Centre Street, or for a distance of about 2,800 feet along the shore, and between the National Docks Railroad and the Pierhead Line. This area consists of approximately 420 acres of which but a little over 19 are upland and the remaining are lands under water. The total area of the property from mean high water to the bulkhead line is about 303 acres. The total area from the high water line to the pierhead line is 401 acres. Of the 401 acres of lands under water, practically all of it is owned by the tSate of New Jersey as is seen when it is observed that the State owns 1681.81 front feet of the total of 1909.2 front feet measured along the bulkhead line established by the State within the limits of the property selected. In other words, the State of New Jersey owns nearly all of the property involved in this undertaking as the 19 acres of upland constitutes less than five per cent of the total area selected, and these 19 acres are owned by a large number of different persons and interests.

The area selected is separated from the developed residential portion of Bayonne by two steam railroads. The photographs shown on the following page indicate the character and unimproved condition of the upland, the shallowness of the water over the area selected and how close the railroad is to the site.



View of Site of Proposed Bayonne Terminal, Showing Shallowness of Water.



View of Site of Proposed Bayonne Terminal, Showing Proximity of the Railroad to the Water and the Undeveloped Character of the Upland.

Acquisition of Site.

Under the law the State is the owner of the lands under water outshore of mean high water, unless and until it has parted with the title, and the owner of the uplands has the first right to apply for the lands under water. It is possible for a non-upland owner to acquire lands under water from the State but only after six months notice shall have been served upon the upland owner.

As the City of Bayonne is not the owner of the upland it is not in a position to apply to the State for the lands under water in question, but for the purpose of an operating contract and for the purpose of estimating on the cost of the improvement it is necessary to know under what conditions and on what terms the City can acquire the rights to the lands under water, now the property of the State. -In order, therefore, to bring this matter formally before the Board entrusted with the custody of the State's lands under water, the following resolution was adopted by the Board of Commissioners of the City of Bayonne and is now under consideration by the Board of Commerce and Navigation.

WHEREAS, the City of Bayonne has in contemplation the acquisition of lands and lands under water in upper New York Bay to be used for the construction and operation of a Marine Terminal and Industrial City, and

WHEREAS, it is necessary for the proper consideration of the project and for the making of plans and estimates to know the terms under which the necessary property can be acquired, and

WHEREAS, it is impossible at this time for the City of Bayonne to make application for the riparian rights owing to the fact that it does not own the uplands, and

WHEREAS, the State of New Jersey is the owner of practically all of the lands under water on which this proposed terminal is to be constructed, BE IT THEREOFRE RESOLVED, that the Board of Commissioners of Bayonne request that the Board of Commerce and Navigation of the State of New Jersey give consideration and inform the Commissioners of Bayonne as to the form and terms of a permit, lease, grant or other form of conveyance in which the City of Bayonne may acquire from the State of New Jersey the necessary lands under water on which the proposed terminal is contemplated, and which are shown on the accompanying map.

Engineering Organization.

While the work of determining the character of the development and the selection of the site was in progress, the engineering force required to make the essential investigations and to prepare the necessary studies, drawings, plans, and estimates was being organized and suitable working quarters selected, prepared, and equipped.

Through the courtesy of Commissioner Roberson two rooms in the Park Building, located at the foot of West 15th Street, Bayonne, were assigned for this purpose, cleaned and put in proper condition for occupancy. One of these rooms was fitted up as a draughting room and the other as an executive office. Minor office supplies and drafting supplies were purchased at a cost of about $65.00.

As the work in connection with these engineering studies is of a highly specialized character, it was necessary to find engineering assistants qualified by experience to undertake the work. On June 17th, Mr. S. W. Hoag, Jr., who has been connected with the New York Dock Department for more than twenty years, and who for a number of years was the deputy chief engineer and who has recently retired from the Dock Department, was engaged to spend a portion of his time on this work. It did not seem that we were justified in paying Mr. Hoag what would be proper should he devote all of his time to the work, but the arrangements made with him were reasonable and it has developed that Mr. Hoag has spent practically all of his time on this work, thus we have had the benefit of a long experience in harbor construction works at the Port of New York. There being a considerable amount of detailed railroad work connected with the proposed terminal it was deemed advisable to employ a man skilled in that particular phase of engineering, and Mr. George W. Wasley, who had been for many years employed by the Delaware, Lackawanna, and Western Railroad on track layouts and other special engineering problems, was found available and was employed commencing June 19th.

In order to make the tracings and studies and to assist in the estimates, Mr. Clarence Steiner, who has had considerable general engineering experience, and is familiar with local conditions at Bayonne, was employed commencing July 10th. This comprises the engineering force which has been employed directly on this work.

Subsurface Investigation and Determination.

The character of the subsurface material within the boundaries of the site of the proposed terminal is a determining factor in considering the type and method of waterfront construction and in estimating the cost of such construction within reasonable limits. A definite knowledge of this is also necessary in order to determine the cost of dredging and the amount of dredged material which would be available for reclamation work. As the cost of these phases of the project is one of the important factors in determining its economical feasability it was deemed advisable to make an exhaustive and as complete a subsurface investigation as possible.

Although we feel that it will be necessary and essential to confirm our opinion concerning the character of the surface material by borings or test piles before the adoption of any final plans or the preparation of any contracts, we do believe that for the purposes of considering preliminary plans and estimates of cost, we have received sufficient information from authoritative and dependable sources to justify our conclusions.

In a general way the formation indicated is a sloping mud flat extending from the shores of Bayonne and Greenville out to the main channel connecting the Narrows with the North River. Longitudinally it extends from "Black Tom" to Constable Point. The depth of water over this mud is about two feet along the shore and about seven and one half feet at the pierhead line at an average distance outshore of about 9,000 feet. The 40-foot channel is about 3,000 feet beyond the pierhead line.

The scope and reliability of the investigation as to the character of the underlying material can probably be best understood by quoting from the report made by our assistant, Mr. Hoag, on his conferences with various experienced interests on this subject in the vicinity of the projected site, such as contractors and railroad officials and grateful acknowledgment is made to those who so courteously supplied this information.

Quotations from Mr. Hoag's Report on Subsurface Material.

"The Bayonne Peninsula was originally a 'trap dyke,' the trap rock forming the backbone of Bayonne, terminating at the Hook in an island created by a natural channel which used to cut in from the Kill Van Kull at Fort Johnston just westerly of the Standard Oil docks, and extended in a northeasterly direction to the main channel northerly of Robbins Reef. The original bottom of this locality was hard sand and gravel with a plentiful supply of boulders extending from the aforesaid island nearly to Caven's Point. A sand fill has been deposited over this hard bottom by natural processes, the depth of hard bottom being about –12 feet in the vicinity of the shore, about –15 feet, 3,000 feet outshore, and –20 feet about 7,000 feet outshore. Over this sand fill time has deposited a blanket of mud varying in thickness from 5 to 10 feet. Pinnacles of rock occur along the shore. Below the Greenville freight yard of the P R. R. there is no rock in evidence outshore at any ordinary depth. At the Hook the Lehigh Valley Railroad carried dredging to –30 feet. Half of the material was hard sand and sand and boulders. The area within the lines of the proposed Bayonne Terminal is located within the area discussed in this statement."

"We studied the proposition for constructing the outfall sewer into the New York Bay as presented in the plans of the Passaic Valley Sewerage Commission, and for this purpose used five sheets of blue print plans, belonging to section 2 of the said commissioners' plans, which were placed at my disposal, first in the nature of borings carried in many cases to rock. The line of the Passaic Valley Sewer outfall extends generally in a southeasterly direction from the shore cutting the Riparian Commissioners' pierheadline of 1883 at a distance of about 1,050 feet southerly from the northerly line of the tract involved in the proposed Bayonne Terminal and cutting the northerly line of said tract about 350 feet outshore of the established bulkhead line. It will, therefore, be seen that the line of this sewer outfall cuts diagonally, through the property involved in the Bayonne Terminal. The average thickness of mud is ten feet, the average thickness of sand is eighteen feet. This sand which varies from fine red to gray sand with gravel overlies the reddish hard sand which is termed by the Passaic Valley Commission 'Cemented triassic formation.' This formation belongs to the triassic period of Mesozoic time and comprises red sandstone and clay of the New York foundation strata and consists of red sand in combination with fine and coarse gravel to the size of boulders cemented together by a natural process forming a mass plastic to the fingers but which dries out to the hardness of rock. It is sufficiently plastic, in my opinion, in its native or undisturbed state to permit of cutting with a proper dredging machine.

"Below this hard pan or cemented triassic formation is decomposed schist and trap rock into which a drill was carried in places to a depth of ten feet."

"The information furnished from this source is identical with the foregoing and in addition I was shown cores derived from borings, illustrating the character of what the commission calls 'cemented triassic.' The tunnel was driven through rock at a depth of about eighty feet below mean low water, with about two feet of rock over the crown of the tunnel"

"According to this source at Constable Hook hard bottom occurs at about –25 feet. Piles about 45 feet long were driven in work.

"At the Greenville freight yard hard bottom occurs at about –50. Piles driven are about 50 feet long.

"At the national docks the channel was dredged to –30 and involved digging into red shale.

"At the Jersey Central Pier 14, piles were 35 to 45 feet long."

"We have done some dredging in this locality and from our observation water there is in depth from 6 to 15 feet, and sand overlying hard pan and boulders. No rock was encountered except a ledge running in a northeasterly direction across the center of the inshore channel leading to the National Storage Company's docks."

"We had charge of the construction at the Greenville Terminal for the Pennsylvania Railroad and we are familiar with bottom conditions at that locality. We had three borings taken at the established bulkhead line, one at the intersection of the northerly property line, one at the southerly property line, and one midway between. These borings indicate water, 5 feet; mud, 4 feet; fine sand, 5 to 30 feet; gravel and sand and hard pan, 15 feet; and hard rock at a depth of –35.

"Piles drive hard in the hard bottom with an average elevation of pile points at –38. Ship dredging was carried to –18 feet and observation by Mr. B. is worth recording, namely, that this slip dredging does not fill rapidly and in twelve years the depth has been maintained without any particular trouble.

"In driving piles for the bulkhead work which was crib work on piles, the latter drove so hard that a water jet had to be used in many cases."

"The Federal Government has not had occasion to study the structure of the bottom of this locality and therefore has little more than soundings over the mud flat. In 1881 it made an attempt to develop some rock contours on a reef lying just westerly of the Oyster Islands. These contours were developed from borings determined by a hydraulic machine before the operators had become accustomed to taking wash borings. This development shows contours at three-foot intervals, from 6 to 21 feet below mean low water, but only over this reef.

"The examination made in 1881 in the vicinity of the Riparian Commissioners' bulkhead line extending for a distance of 12,000 feet southward of Caven's Point developed hard bottom at a depth of about 16 to 20 feet below mean low water, with an average depth of water 5 feet and of mud 6 feet."

"Generally speaking the water is from 5 to 6 feet deep, mud, 15 feet deep; gray sand extends to a depth of 30 feet below mean low water, and red sand to 65 feet below mean low water, with hard pan and boulders overlying the red sand.

"There is no rock in the slips within 100 feet of mean low water but rock occurs in three places at about –35. The Lehigh Valley Railroad has copious notes, derived from borings, which have not yet been compiled or plotted, as the men are very busy just at present on other work, and there does not seem to be any prospect of whipping this information into shape inside of about three months. At that time, I am assured, we can have all of this information."

"Soft mud occurs in the slips and near piers of the C. R. R. of N. J. Red sand at –32, hard pan and boulders at –30. In some of the channel dredging rock was encountered which had to be blasted at a cost of twenty-five dollars ($25) per cubic yard. Mr. O. has a couple of tracings on which water jet borings are plotted. These tracings are designated 2609 A-3 sheets 1 and 2. He will send blue print copies on written application on request from Mr. Cresson. These blue prints show the locations of water jet and rod borings with depths of mud, sand, gravel, boulders and rock. They are taken about two hundred feet apart on parallel ranges, generally parallel with Pier 10 of the C. R. R. Piers.

"In the vicinity of 'Black Tom' and to the northerly thereof rock varies in depth from –15 to –40.

"Between Ellis and Bedloe's Island there is no rock at a depth of –48 or higher, but there is rock near the westerly end of Bedloe's Island at –22, and for a distance of about 100 feet southward of Bedloe's Island there is practically no rock at as high an elevation as —35. There is, however, over the entire locality, an abundance of hard pan and boulders at a depth of about 15 feet below mean low water.

"Outshore of Pier No. 19 and northerly to Ellis Island, the average depths below mean low water are:—

to mud	3.2	feet
to silt	15	feet
to sand	19.8	feet
to gravel and boulders	22.4	feet
to rock	29.6	feet

“In the slip between the C. R. R. Piers No. 8 and 10 the depths below mean low water are:—

to silt	11.2	feet
to sand	26.6	feet
to rock	29.3	feet

“Westerly of Ellis Island and southerly of Pier No. 10 (C. R. R.) the depths below mean low ater are:—

to sand	13	feet
to sand	13	feet
to clay, gravel and boulders	18	feet
to rock	22.4	feet.”

“According to borings, there is a depth of 10 feet of mud, 15 feet of sand and below that is a ‘cemented triassic formation.’ This conforms with the information derived from the Passaic Valley Sewerage Commission. ‘Data obtained from the U. S. War Department states that wash borings taken by the Passaic Valley Sewerage Commission show that borings No. 382 to 388 which are on the property within the lines of the proposed improvements show 4 to 8 feet of water to 5 to 10 feet of mud, 16 to 29 feet of sand, 23 to 29 feet of cemented triassic formation making a total penetration of about 68 feet below mean low water. A boring at the pierhead line showed 7.2 feet of water, with hard sand at a depth of 62.7 feet below mean low water. The top of the sewer is about 69 feet below mean low water at the pierhead line.”

“This concern took three lines of wash borings in 1888 on P. R. R. property, 220 to 300 feet east of the easterly line and extending into the bay about 11,600 feet. A total of 18 borings were taken varying in depth from 15 to 45 feet. Near the shore rock was struck at 15 feet below mean low water. The other borings stopped in sand."

Conclusions as to Subsurface Material.

From a careful consideration of the above we have come to the following conclusions:

That the depth of the water in the locality in question is from 2 to 7½ feet.

That directly below the water is a mud blanket about 10 feet in thickness.

That immediately underlying the mud is a sand foundation about 18 feet in thickness.

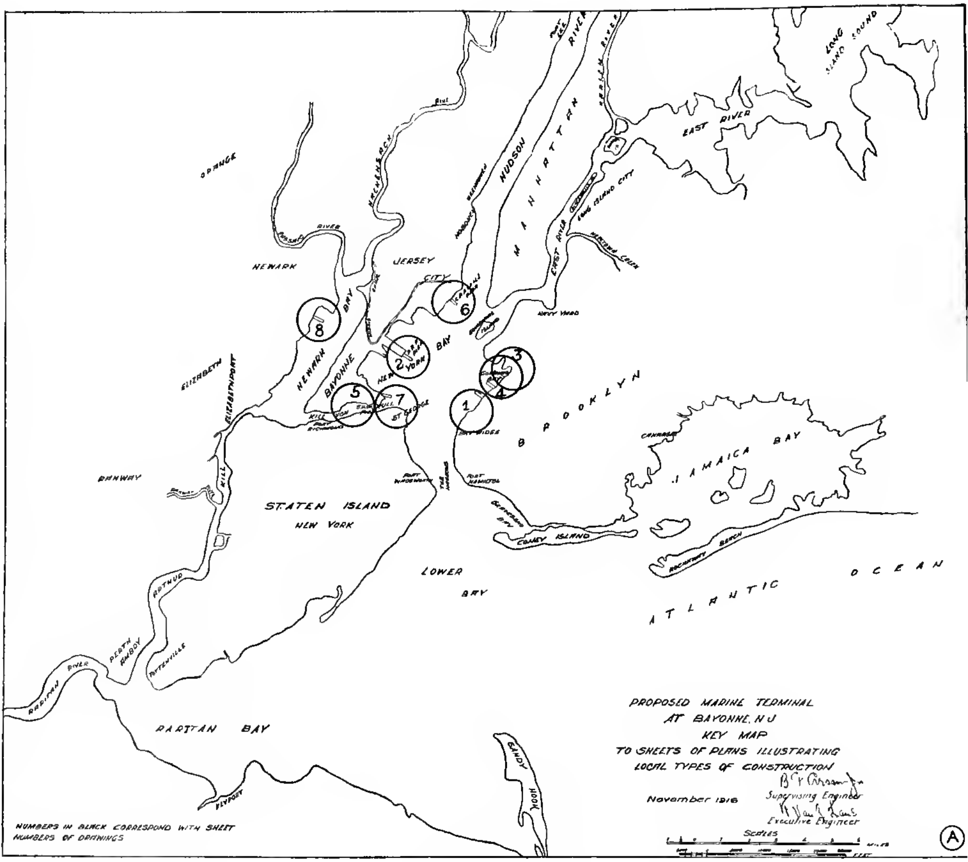
That underlying this sand is a material designated by the Passaic Valley Sewerage Commission as "cemented triassic formation" and that this extends to rock which lies at an average depth of about 60 feet below mean low water.

The mud in the slips and in the channels should be dredged off and taken to sea, and disposed of. A bulkhead should then be built and the sand and cemented triassic formation should be pumped behind this bulkhead. These materials, from the best information we have been able to get, can readily be pumped with the modern dredging machines and the estimated cost of the dredging as we have estimated it is ten cents per cubic yard for the mud dumped at sea; thirteen cents for sand pumped behind the bulkhead and thirty-five cents for the material known as cemented triassic formation.

Bulkhead, Pier and Platform Construction.

Having learned the character of the subsurface material the next step was to determine the most advisable type of bulkhead, pier and platform construction to be employed.

Certain general types of construction have been employed along the shores of the upper New York Bay, and it was deemed wise to carefully study the various types in order that we might

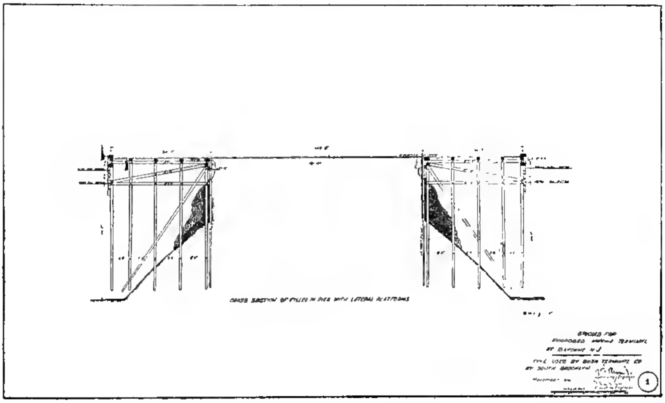


Key Map to Plans Illustrating Local Types of Construction.

be informed as to what was considered the best practice by the City of New York and by the corporations making water front improvements. A Key Map has been prepared, which shows where the different types are located and detail drawings accompany this report, the Key Map being designated by the letter A and the Type Maps are numbered from 1 to 8 inclusive. A detailed description of these various types has been prepared by our assistant, Mr. Hoag, and is as follows:

Types of Construction Which Have Been Employed and Recommended in the Immediate Locality of the Proposed Bayonne Terminal.

Bush Terminal Company at South Brooklyn.


CROSS SECTION OF FILLED IN PIER WITH LATERAL PLATFORMS
STUDIES FOR
PROPOSED MARINE TERMINAL
AT BAYONNE N.J
TYPE USED BY BUSH TERMINAL CO
AT SOUTH BROOKLYN
①

Drawing No. 1 illustrates the construction used at the Bush Company's Docks in South Brooklyn. The essential features are the braced retaining structure, and the lateral platform for wharfage. The retaining structure, within and behind which the material obtained on the site of the work by hydraulic dredging is deposited, consists of a row of tongued and grooved six inch yellow pine sheet piling, supported on the outshore face by inclined or bracing piles fastened at the top to vertical piles by bolting. These vertical piles bear against 8″ by 12″ waling pieces, one at about mean low water, and one at about mean high water with a waling piece at the top front of the sheet piling supported in front by one of the platform rangers. A platform on vertical piles is built in front of the sheet piling structure half clamped at the top with a 6″ by 12″ clamp. The dock, which consists of two courses of 3″ planking, is laid upon these rangers. The platform is braced at mean low water with a horizontal brace and with a diagonal brace extending from the outshore end of the horizontal brace to the inshore end of the half clamp.

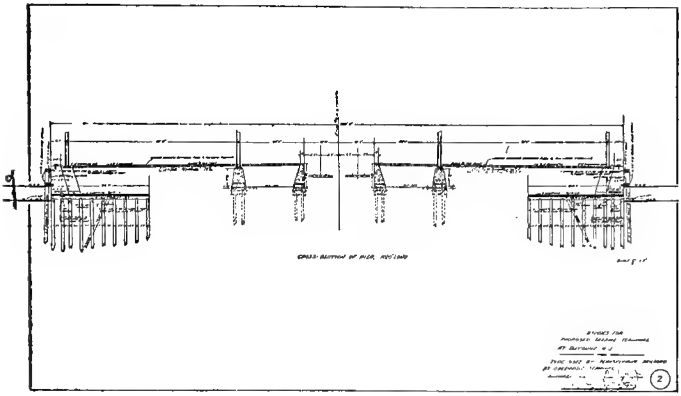
The fender system consists of 8″ by 12″ white oak timber fastened vertically to the outshore face of the end pile in each row, extending from the top of the backing log to about four feet below mean low water with a length of 14 feet chocked at the top and at the bottom of the side cap with 8″ by 8″ white oak horizontal chocks.

The filling in the rear of the sheet piling is planked over with 3″ yellow pine planking.

The dredging for slips is carried to a depth of 40 feet below mean low water, sloping upward from the side of the platform to a depth at the sheet pile retaining structure of about 13 feet below mean low water. The platforms are about 34 feet wide oustide of the slope, extending from the bottom of the horizontal brace at the sheet piling to the foot of the slope at the outshore of the platform.

As a type embodying the essential features of a filled-in pier, this construction shows very well for the two main features, that is, the braced retaining structure and the wharfage platform; but, the construction, in this case, is too light for the purpose intended. The piles are too far apart and the bracing pile at the top or butt end is not fastened or framed in a manner consistent with a first class dock building job.

Pennsylvania Railroad Pier at Greenville, N. J.

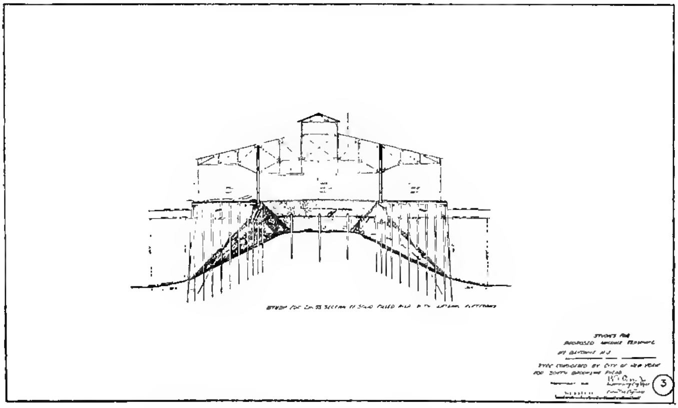


Drawing No. 2 illustrates the low grade type of construction such as that now being built by the Pennsylvania Railroad at Greenville with a length of 1,020 feet and a width of 200 feet. The interior or filled-in portion proper is retained in place by riprap embankments covered with cellar dirt. The cellar dirt is used for filling in the crevices amongst stone to prevent and retard the percolation of the sand filling through the riprap embankment. The lateral platforms in this construction are low grade and filled in on top, the filling being retained by means of concrete walls built on top of the platform along the wharfage face, forming not only a retaining structure for the filling, but also a wharfage for vessels. These platforms are 34 feet wide, supported upon vertical piles arranged in parallel rows on 5-foot centers. The piles are capped with 12″ by 12″ yellow pine timber notched two inches over the piles. Each pile row is also braced with a bracing pile and the platform, therefore, becomes a buttress to the retaining structure. A flooring is provided for receiving a super-imposed filling over these platforms by means of a 6″ by 12″ creosoted yellow pine piece. The traffic floor over the platform area is a very hard material consisting of what is called "master builders' compound" which is a concrete with considerable iron in the mixture and adapted to resist heavy trucking. This type of pier is admirably adapted for the construction of foundations for the subsequent sheds and buildings that may be built over the pier area. Longitudinally along the center of the pier provision is made for a depressed double track railroad.

The fender system is very effectively fastened to waling pieces anchored to the outer face of the concrete wall, and lends itself very efficiently to this type of construction. Thus the wall also serves as a foundation support for the outer posts of any structure such as a single or double dock shed. The slips along the wharfage side in these platforms are designed to be 30 feet deep at mean low water.

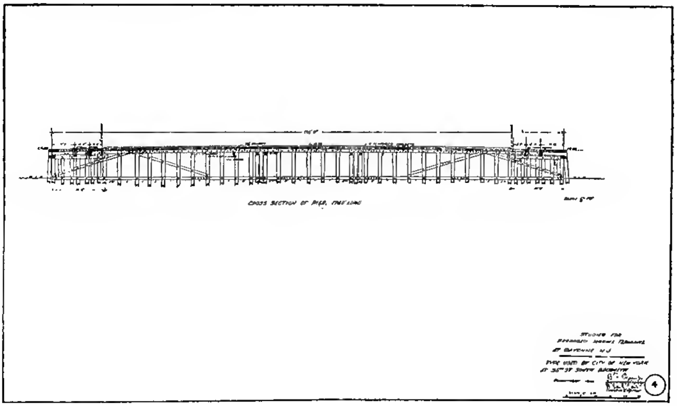
The principal point of criticism in this particular type of pier is the fact that insufficient support is provided by the toe of the riprap embankments against future dredging and the inevitable sloughing off of the toe of the embankment. Within the limits of reasonable cost, I regard this as one of the best types of filled-in piers.

New York Dock Department Pier at South Brooklyn (proposed).



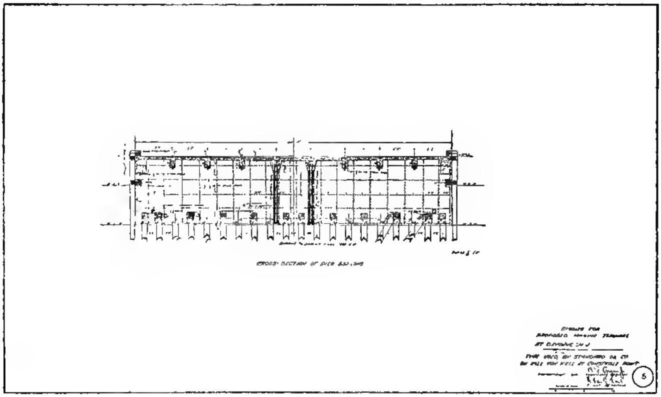
Drawing No. 3 illustrates a type of filled-in pier which was originally intended to be built in that portion of South Brooklyn known as the Gowanus Section. The essential features in this type are legitimate retaining walls or bulkhead walls supported on vertical pile foundations and enclosed with riprap and cobble embankments. The concrete portion of these walls is anchored back by means of two inch steel rods to anchor piles, by which means the opposite walls of the pier are tied completely together across the pier. Along each side of the pier outshore of the retaining walls is a wharfage platform about 37½ feet wide. These platforms are built on vertical piles braced under every pile row with a bracing pile as well as horizontal and diagonal bracing. The wearing surface of these platforms is a 2½" asphalt pavement laid upon a reinforced concrete dock, the platforms thus becoming powerful buttresses against any outward thrust caused by the filling of dredged material. It was originally intended that a granite pavement should be laid over the solid portion of the pier, but the construction lends itself very readily to a wooden decking laid upon sleepers buried in the filling. The fender system is readily applied to the wharfage face of these platforms. I do not hesitate to pronounce this type of structure as the best design for a filled-in pier, but there are two elements in its construction that at the present time particularly are apt to be very expensive. These are the concrete retaining walls and the riprap embankments, and it was for these reasons that this type of pier was abandoned in favor of the pile pier shown in drawing No. 4.

New York Dock Department Pier at 35th Street, South Brooklyn



Drawing No. 4 illustrates in cross section a pile pier which is rapidly approaching completion at the foot of 35th Street, South Brooklyn in the Gowanus Section, and is the largest pier built by the City of New York. It has a length of 1,740 feet and a width of 175 feet. It is in no sense a filled-in pier, but consists of 170 rows of piles generally on 10-foot centers, clamped together at the sawed off ends with a pair of 6″ by 12″ yellow pine clamps bolted and shouldered to the piles. Each pile row is braced with 5″ by 10″ diagonal yellow pine bracing. The shed on top of the pier, a single story structure, is supported upon foundations built into the pile system. It is also built to carry a railroad track on each side outside of the shed. The deck of this pier is a ten inch reinforced concrete slab covered with a 2½″ asphalt traffic or wearing surface. The deck of this pier is at an elevation of ten feet above mean low water. None of the piles or timber is creosoted.

Standard Oil Company Pier at Constable Point, New Jersey.



Drawing No. 5 shows how the question of locality affects construction. At Constable Point, near the entrance to the Kill Van Kull, the Standard Oil Company has built a pier shown in drawing No. 5, which is essentially a pile pier. The entire super-structure is re-inforced concrete. The piles themselves were creosoted and cut off at about one foot above mean low water, the concrete construction being carried from this level up to and including the deck surface by building a concrete wall across the pier from side to side, the concrete wall across the pier from side to side, the concrete girder construction for the support of the floor and deck being merged into this concrete transverse wall construction near the top thereof. The pile system for each transverse bent in the pier comprises two parallel rows of piles 2′6″ on centers, the piles in each row being driven on 2′9″ centers. Each of these rows of piles is clamped at the top with a 6″ by 12″ creosoted yellow pine clamp bolted through the pile. At the opposite ends of each bent three bracing piles are driven between parallel rows and arranged in tandem. These bracing piles are shouldered against the underside and interior face of the stringers hereinafter described.

A transverse wall of re-inforced concrete is laid upon this construction with its base one foot below the tops of the cut-off piles, with a width at the bottom of 5 feet extending upwards with opposite sides tapering toward the center of the wall at the top where its width becomes 2 feet. These transverse walls are re-inforced with ⅞″ square steel rods arranged vertically on 3 foot centers across the pier and horizontally on 2′7″ centers.

The base of the tie-walls is 12 inches below the top of the piles with a height of 8 feet. The width of the base is 9 feet and at the top 2 feet 6 inches. These tie-walls are heavily re-inforced, the longitudinal re-inforcement projecting with a flare into each of the two unloading walls.

The longitudinal system consists of re-inforced concrete girders with a depth of 18″ and a width of 12″ built into and upon the transverse concrete walls, and arranged parallel with the sides of the pier on 6-foot centers.

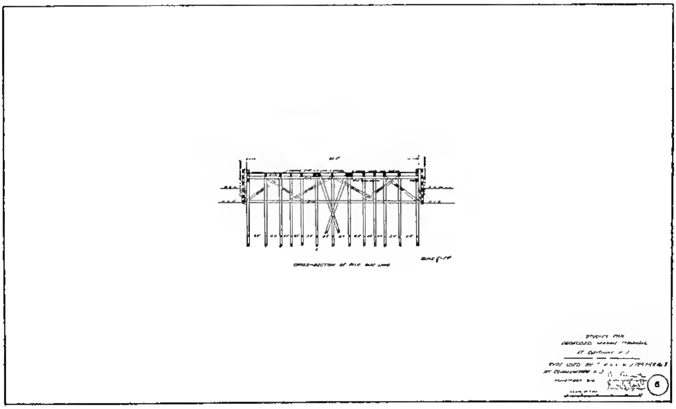
The deck system which is a re-inforced concrete slab construction having a thickness of 6″, is built upon and merged into the girders at their tops. The re-inforcement for the girders consists of three ⅞″ square steel rods. The re-inforcement for the deck consists of ½″ square twisted steel rods arranged on 24″ centers.

A 12″ re-inforced concrete curtain wall is built longitudinally of the pier about 3 feet from the center. This curtain wall is of doubtful utility for its function is that of a fire preventive or a preventive against the spread of fire, the danger from which in a structure of this kind is so remote that the expense attending the construction of this curtain is hardly justified.

The fender system on each side of the pier consists of a vertical white oak pile at the end of each bent, chocked between piles, the chocking being fastened to 12″ by 12″ creosoted yellow pine waling strips in turn bolted to the concrete transverse walls.

This pier is about 550 feet long and 50 feet wide. The creosoting of piles and timber practically insures the permanency of the structure against the ravages of the teredo, and the concrete construction insures the permanency of the structure against fire.

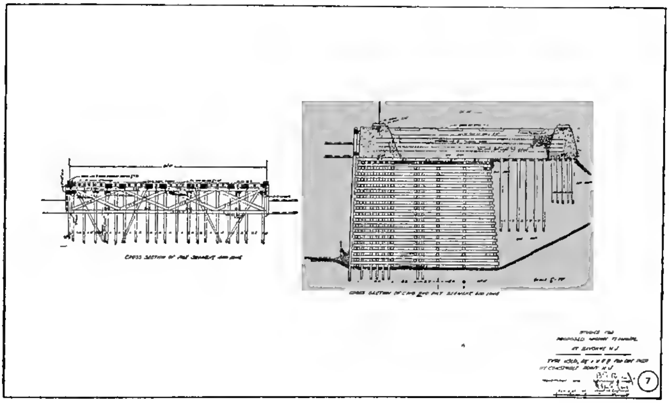
Central Railroad Company of New Jersey Pier at Communipaw, N. J.



Drawing No. 6 shows a pile pier built by the C. R. R. of N. J. as Pier No. 7 at Communipaw. This pier is 1,450 feet long and 60 feet wide. It is built upon 105 single rows of piles and 16 double rows of piles with a stone-filled crib work occupying the outer 50 feet in length of the pier. In the single pile rows, which average about 12′3″ on centers there are generally 22 piles spaced from 2½ to 6′ on centers with two bracing piles near the center of each row inclined in opposite directions on opposite sides of the row. The pier is built with side caps, side rangers, and interior rangers, serving as track beams, each row is capped with 12" by 12" yellow pine with ends resting upon side caps. The interior rangers or track beams are 8" by 16" yellow pine notched 4" into the cross caps. The decking of 5" by 10" yellow pine is laid upon the rangers across the pier with one inch spaces between planks. Each pile row is horizontally and cross braced from mean low water up to the tops of the cross caps. The sides of the pier are fendered with railroad fendering forming a flush fender system from the deck to mean low water. The piles and timber are creosoted. The pier itself is a very good type of railroad pier. The piles are generally driven to rock which occurs at a depth of about 30 to 60 feet below mean low water.

As a precaution against the spread of fire, re-inforced concrete fire walls are built at intervals across the pier supported upon double pile rows.

Lehigh Valley Railroad Ore Dock at Constable Point, N. J.



Drawing No. 7 illustrates the construction of a pier now under construction at Constable Point by the Lehigh Valley Railroad called the "Ore Dock." The pier has a width of 67 feet, and is built in two segments. The interior segment, 600 feet long, is a combined crib and pile section. The outshore 400 feet is a pile section.

In the crib section the pier is constructed with a regular rock-filled crib along the northerly side, 51 feet wide on the bottom and 45 feet wide on the top, the dredging for this crib being carried to 38 feet below mean low water. Four railroad tracks are supported on the interior portion of the pier, and the crib work also accommodates two tracks for an unloading crane. Each of these two unloading tracks is supported upon a concrete wall, one of which is founded on vertical piles driven through the crib work along the northerly side, and one on vertical piles driven through an embankment of riprap along the southerly side. Each of these walls is a heavy concrete construction and re-inforced. The walls are tied together by a corresponding tie-wall also reinforced with four rows of 1¼" twisted bars in two vertical lines.

The base of the tie-walls is 12 inches below the tops of the piles with a height of 8 feet. The width at the base is 9 feet and at the top 2 feet 6 inches. These tie-walls are heavily re-inforced, the longitudinal re-inforcement projecting with a flare into each of the two unloading walls.

The unloading wall along the southerly side is 10 feet thick at the base, and 5 feet 6 inches thick at the top, the base being deposited 18 inches below the tops of the piles.

The unloading wall along the northerly side of the pier is 14 feet thick at the bottom and 9 feet 6 inches thick at the top, with a height of 11 feet.

Across the inshore and outshore end of this portion of the pier the riprap filling is retained in place by concrete walls 8 feet high, the base of which projects one foot below the tops of the sawed off piles with a thickness of 5 feet 6 inches, and a thickness at the top of 3 feet. These walls are also heavily re-inforced with 1¼-inch and 1-inch twisted steel bars.

The top of the crib work and the bases of all concrete walls are at mean low water.

The ballast into which the railroad ties are laid consists of a thickness of 2 feet 6 inches of cinder and ballast extending between the unloading walls. The tracks are laid on 14-foot centers.

The fender system along the northerly side of this portion of the pier consists of oak piles on 9-foot centers fastened to waling pieces one about a foot below the top of the wall and one about a foot above the bottom of the wall with two strap anchors at each walling piece, one above and one below. The fender-piles are horizontally chocked at each waling piece, the chocking being fastened to the latter.

The slip dredging is carried to 35 feet below mean low water. The excavation along the southerly side of the pier is filled with hydraulic filling.

The finished grade of this portion of the pier is 10 feet 6 inches above mean low water which is the grade of the base of the rails.

The outshore 400 feet in length of the pier, or in other words, the pile section comprises transverse rows of piles on 12-foot centers each row with 18 vertical piles spaced in a row from 3 feet to 5 feet 6 inches. Each row is capped with 12″ by 12″ yellow pine. The side piles of the pier instead of being side-capped, are clamped with two 8″ by 12″ clamps, and the cross caps extend from out to out of these clamps.

Each row is horizontally braced with two 6″ by 12″ horizontal braces bolted to the piles with the bottoms at mean low water. The pile rows are also braced on each side with diagonal 4″ by 12″ bracing extending across the pier in four panels.

Each row is furthermore braced with four bracing piles one at each end and two in the interior portion of the pier.

The ranger system, or floor beam construction of the pier consists of three 8″ by 16″ track beams laid longitudinally under each rail, notched down four inches over the cross caps with 4″ by 12″, 6″ by 12″ and 12″ by 12″ floor beams in between.

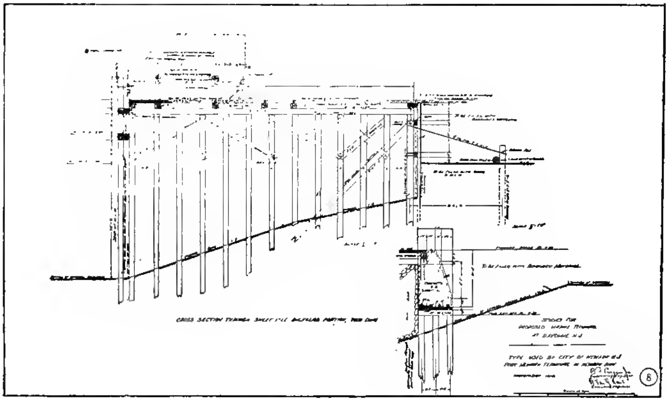
These rangers are decked over with 3″ by 10″ yellow pine deck planking, the top of which is at a grade of ten feet six inches above mean low water. A 12″ by 12″ backing log is laid along each side of the pier.

The fender system consists of 8″ by 12″ oak fenders fastened to each side bearing pile along the northerly side of the pier with a 4″ by 12″ strip or filling piece between the pile and the fender. The white oak fenders are capped at top with an 8″ by 12″ oak fender cap with its top flush with the top of the backing log. The fenders are furthermore chocked on the level of the side clamps with 8″ by 12″ horizontal chocks. The white oak fenders extend to about six inches below mean low water and are rounded at the bottom. Along the south side of the pier railroad fendering is fastened extending from a fender pile cap to about mean low water.

In this pier the bearing piles, bracing piles, caps, rangers, bracing, and timber floor are long leaf yellow pine treated with creosote oil. Owing to the difficulty of repairing and replacing members of a pier of this description the creosoting is as much a medium of permanency as insurance against the teredo.

The piles drove very hard and the greatest penetration has been ten or twelve feet. The piles were from fifty to fifty-five feet long.

City of Newark Pier at Port Newark Terminal, Newark Bay.



Drawing No. 8 illustrates the construction of a pier built on Newark Bay know as the "Newark Bay Development Project." It is a solid-filled pier between two walls of concrete founded on a pile and grillage platform for a part of the length and on bulkheads for the remainder of the length, outshore or in front of which is built a lateral platform. This lateral platform is built on vertical piles and otherwise arranged for wharfage. The platforms are built at a grade of 11 feet above mean low water except that for one thousand feet of the pier the outer twenty feet in width has a grade of about 15 feet above mean low water, constructed by supporting this raised portion upon bents consisting of four posts capped with 12″ by 12″ sticks and cross-braced with 4″ by 12″ bracing springing directly from the cross caps. This raised portion of the platforms is for the accommodation of a movable crane rolling upon a track which has a gauge of 10 feet. The rails are supported upon 12″ by 12″ track beams or stringers with side rangers of the same size.

Each of the platform bents which are on 6-foot centers is cross braced with 4″ by 12″ bracing in four panels, the bracing being on opposite sides of the pile row in each case. All of this bracing s bolted through the piles.

Along the outshore face of the concrete retaining wall an embankment of riprap is deposited from the underside of the cross caps down to the bottom with a slope of 45°.

The sheet pile bulkhead portion comprises a section about 2,000 feet long. The sheet pile bulkhead is constructed of 6″ by 8″ sheet piling cut off at an elevation of 10½ feet above mean low water, each vertical joint on the inshore face being covered with 1″ by 3″ battens. The support for this sheet pile bulkhead comprises vertical piles on 4-foot centers bearing against two horizontal 8″ by 10″ waling pieces fastened along the face of the sheet piling 4′10″ apart, the upper one being placed one foot below the tops of the vertical cut-off piles. There is also a top waling piece of 8″ by 16″ yellow pine laid horizontally with its top edge about 6″ above the top of the cut-off sheet piling. This bulkhead is also braced with bracing piles on 8-foot centers, driven at an angle of 45°. These bracing piles occur at every alternate vertical bulkhead pile, to which it is bolted at the top wale. Every alternate vertical bulkhead pile is also anchored back to an anchor pile with a 1¾″ tie rod. These anchor piles are driven vertically behind the sheet bulkhead pile at a distance of 16 feet from the vertical bulkhead pile. A dead-man pile is laid horizontally at mean low water in front of the anchor piles bolted to the latter with one inch screw bolts.

For the solid-filled portion of the pier the filling is sand up to mean low water. Between this point and the finished grade the filling is made with "borrowed material."

The fender system consists of white oak piles driven at the ends of alternate bents. These piles are chocked out with 10″ by 12″ yellow pine wales and fastened thereto at the cross cap level and 3′6″ below. The piles are otherwise chocked between with horizontal chocks of 10″ by 12″ yellow pine fastened to the waling pieces. The slip dredging is carried to 20 feet below mean low water and then sloped up on a slope of 1 to 3 and 1 to 5 under the lateral platforms until this slope intersects the surface of the meadows in the filled-in portion of the pier.

The concrete retaining structure is supported upon a platform or grillage for which the piles are cut off six inches below mean low water, capped with 12″ by 12″ yellow pine caps, and decked over with 6″ by 12″ yellow pine, alternate streaks being placed on edge. The concrete wall is re-inforced with ¾″ bars bedded three inches from the face of the concrete. The wall itself is 10 feet high, and has a shouldered recess in front at the top or seat upon which the caps of the lateral platform rest. The inshore ends of these caps are anchored with anchor bolts to the wall. These walls, which are six feet thick at the base, form the principal retaining structure for the solid filling in addition to the sheet pile section. The platforms are so built as to buttress these walls at the top by means of the caps which are placed transversely upon the piles cut off flat-footed at an elevation of 8½ feet above mean low water. The 12″ by 12″ caps extend transversely for the full width of the platforms, the piles in each bent being on 4-foot centers. 12″ by 12″ yellow pine rangers are laid longitudinally across these caps to serve as track beams, the platform bents being on 6-foot centers. 12″ by 12″ fillers extend between these track beams laid on top of the cross caps to receive the 3″ by 12″ deck planking which is laid perpendicular to the platform bents. On top of this decking is laid the 3″ by 12″ sheathing, diagonally.

All bearing piles in this structure are creosoted with sixteen pounds of creosote per cubic foot of timber.

Summarized Discussion and Review of Local Types of Construction.

A review of the foregoing plans shows that in this locality, that is, in the locality comprising the upper New York and Newark Bay, a certain degree of uniformity prevails in the matter of design. In all, eight different plans have been described, all having the same general object in view, that is, the construction of a pier structure with a wharfage face on one or both sides, with slip depths obtained by dredging varying from 20 to 40 feet below mean low water. The character of these structures varies from an open pile structure throughout, under which the tide can ebb and flow, to a solid-filled structure, the filling presenting an absolute barrier against the flow of tide, with wharfage faces on each side, created by a platform construction varying in width from 20 to 50 feet.

The slip dredging in all of these cases varies from 20 to 40 feet below mean low water.

In all cases discussed, with the exception of the New York City piers, creosoting of piles has been resorted to.

The prevailing finished grade of wharfage platforms and piers is 10 feet above mean low water.

The bracing of pile work is the usual dock building bracing varying somewhat in character according to the character of the pier, that is, the bracing is heavier in the railroad piers than in others.

The retaining structures for the solid-filled portions of the piers vary from braced sheet piling to concrete walls. In one of the piers riprap embankments covered with cellar dirt are used for this purpose.

Materials for Bulkhead and Pier Construction.

Untreated timber, treated timber, concrete.

In order to arrive at a conclusion as to the material required for permanency in construction careful investigation has been made as to the danger to apprehend and the provision against the ravages of the teredo navalis.

The safest guide in this matter is local experience. It is well known that in the past the teredo has been active in New York Harbor, and in parts of the harbor where the water is clean, the teredo is still active. In most parts of the Harbor where structures have been built, the waters are so polluted by sewerage that the teredo does not exist, but it appears to be only a question of time when the practice of dumping sewerage into the harbor waters must cease and when this time comes cleaner water will be found in the harbor and it is probable that the teredo will return. Following is the investigation made by Mr. Hoag on this subject:

"The Department of Docks and Ferries of the City of New York after an investigation decided to use untreated timber in the piers which it has built on the easterly side of upper New York Bay. The pollution of the waters from the Gowanus Canal which empties into the bay near these piers has resulted in eliminating the teredo from this locality and no precautionary measures were taken such as the use of creosoted timber, or of concrete piles. At the Bay Ridge Avenue Pier, however, near the Narrows, the City of New York used creosoted piles and this was done because of the proximity of this pier to the clean sea water. The teredo will not operate in polluted water but demands clean sea water.

"At the ferry terminal constructed by the City of New York at Stapleton, Staten Island, there have been recently removed some 1,300 oak piles from the ferry rack and practically no trace of the teredo was found. One of these piles was sawed into three different sections in order to confirm this conclusion.

"At the municipal ferry terminal at St. George, S. I., about 100 piles were removed from the South Street approach to the ferry with the same result regarding the teredo and these piles had been in for many years. At the time of the construction of this ferry terminal a number of old piles were removed which had been in for many years and these were found to be very badly eaten, but no live teredo were found at that time. The absence of the teredo at St. George Terminal, has been attributed to the pollution of the waters from the Standard Oil Company's plant on the Kill Van Kull. At the St. George Terminal, however, the Department of Docks and Ferries had all the piles which entered into the construction beneath the ferry house creosoted on the theory that if the teredo should become active it would be more difficult to remove these piles in making repairs than it would in removing piles from an open structure. At the municipal ferry terminal in South Brooklyn at the foot of 39th Street, untreated timber was used. The Department of Docks and Ferries of New York is now preparing plans, specifications, and forms of contract for a new pier to be built at 65th Street, South Brooklyn, which is 15 block south of the Bush Terminal piers and no creosoting of the piles has been provided for.

"At the terminal of the American Dock Company at Thompkinsville, S. I., the extension of two of the piers was built with creosoted timber and Mr. Chandler Davis states that evidences had been found of the activity of the teredo at this locality.

"The Standard Oil Company has recently built at Constable Point at the entrance of the Kill Van Kull a pier 556 feet long and 55 feet wide. This pier is referred to previously and the details are shown. This pier is on creosoted piles cut off at mean low water. These piles support a re-inforced concrete superstructure, and the pier is to be used for loading and unloading ocean steamers.

"The Central Railroad of New Jersey at its New Pier No. 7 in Communipaw details of which are given above, has constructed a pier 1,450 feet long by 60 feet in width and has used creosoted yellow pine piles.

"The Lehigh Valley Railroad Ore Dock at Constable Point described above, is built of creosoted timber, both the piles and the sheet piling.

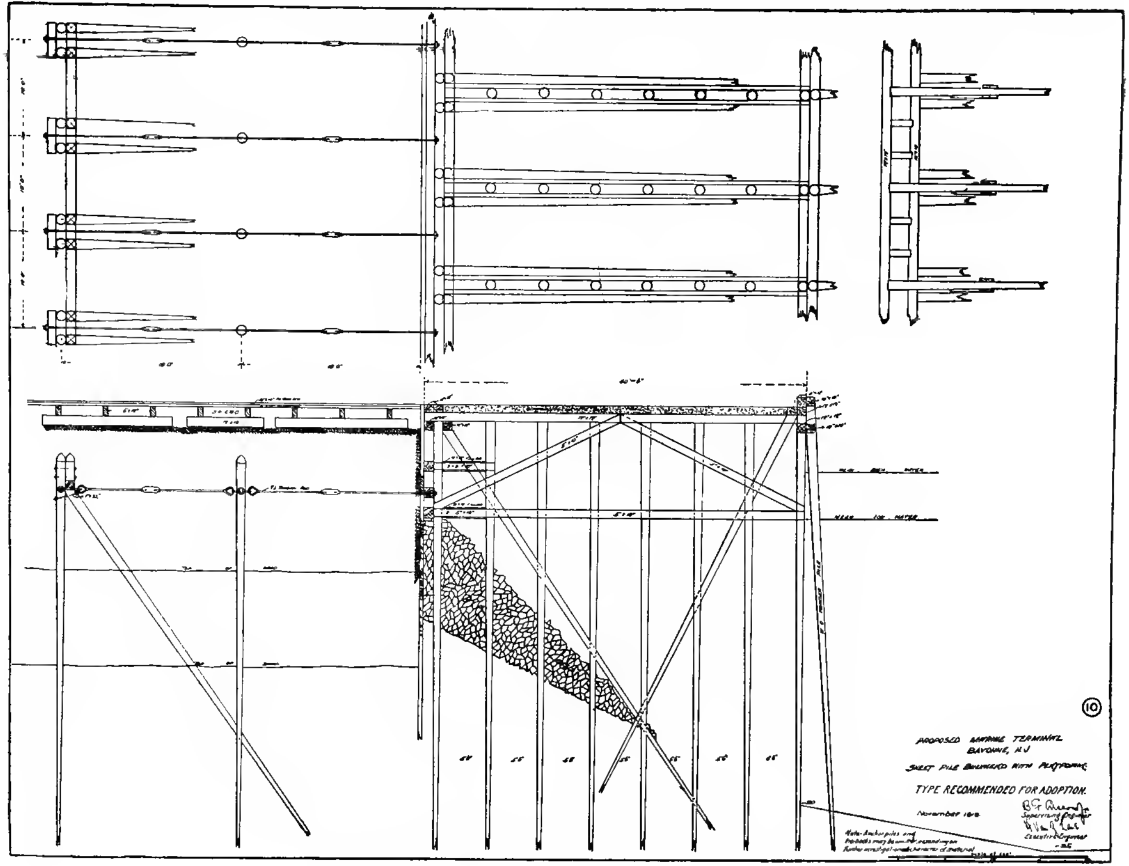
"The Pennsylvania Railroad has built at Greenville a pier 200 feet wide and 1,020 feet long, described above. This is a filled-in pier between two lateral platforms 34 feet wide. The piles in these platforms are 10 in a row with the rows at 5-foot centers. The piles are capped 6 inches above mean low water and backed with yellow pine sheathing 6 inches thick. The piles, caps, and decking are treated with creosote. When repairs were undertaken on one of the piers built at Greenville about 12 years ago, the piles which were untreated were found to be so badly eaten that it was necessary to practically rebuild the pier. This instance and the general use by various pier owners of creosoted piles on the westerly side of New York Bay in the immediate vicinity of Bayonne would indicate that it would be unwise to disregard protective measures against the attack of the teredo."

In his report on the investigation of re-inforced concrete piles, Mr. Hoag states: "In my investigation into the relative desirability of re-inforced concrete piles, I have interviewed several of the most prominent contractors doing this class of work, and I feel convinced that while the permanency of a structure in which re-inforced concrete is used in the piles is beyond all question, the initial cost for the Bayonne improvement makes it rather prohibitory.

"The Raymod Concrete Pile Company makes a re-inforced concrete used in the piles for foundation work in solid filling, but it does not make a concrete pile for an open water way. This same comment applies to the Foundation Company and to the Turner Construction Company. The cost of a re-inforced concrete pile exceeds one dollar per foot per pile. Any of these companies will submit a design accompanying a bid for a pier structure of any kind. Again the use of concrete piles introduces the question of speed in fabrication which is largely a function of facilities for storage, a matter which enters into the cost of the pier.

"While I regard the bottom conditions as favorable for the use of concrete piles, I do not think that their adoption in the Bayonne improvement as against creosoted piles is justified because of their great cost and because of the uncertainty of their necessity from the standpoint of insurance against destruction by the teredo."

From the studies which we have made of the character of structures in this vicinity; of the bottom conditions; of the structures contemplated in the terminal; and of the attack of the marine borers we have designed a bulkhead and bulkhead platform for this terminal which is shown on Drawing No. 10 accompanying this report and which may be briefly described as follows:



Type of Bulkhead and Platform Recommended

Description of Type of Bulkhead and Bulkhead Platform Recommended.

The essential feature of the bulkhead platform is a retaining structure of tongued and grooved sheet piling 6" by 12" yellow pine sheet piling about 25 feet long, driven 15 feet into the hard bottom, beveled on the lower ends to insure close contact between the tongues and grooves in driving. This is important as open joints in a sheet pile bulkhead are bound to leak sand, for sand will generally flow wherever water will. The piling is fastened and held to line by four lines or streaks of 12" by 12" waling, the lower streak set with bottom at mean low water, and second streak 3'6" above the lower one, and a third streak with its top at a grade of 8 feet above mean low water, to provide a seat for the inner end of the platform cross-cap, and a top streak resting upon the inner end of this cross-cap. Vertical piles in pairs will be driven along the front and outside of the wales at regular intervals of 10 feet between the center of each pair which are driven one foot apart so that the above mentioned cross-cap may pass between. Each of these vertical piles is fastened with a 1-inch screw bolt passing through the vertical pile waling piece and sheet pile.

An embankment of riprap will be deposited along the outside of the bulkhead on the sloping bottom with its top at about mean low water. This riprap is intended not only to help buttress the bulkhead at its foot but for protecting the sloping bottom from scour.

In front of the bulkhead thus constructed is built the wharfage platform with a width of 40 feet 6 inches outside of the sheet pile bulkhead. This platform is braced with horizontal and diagonal bracing, and bracing piles and with the reinforced concrete deck will provide a powerful buttress on the outshore side of the bulkhead.

The platform will be supported on vertical creosoted piles arranged in parallel rows perpendicular to the side of the structure 10 feet apart on centers. The piles in each row will be spaced 5 feet 6 inches on centers. There will be seven vertical piles in each row cut off at a grade of 8 feet above mean low water, each pile being provided with a tenon 3 inches wide, 7 inches long, and 3 inches high, and capped transversly with a 12" by 12" yellow pine cross-cap mortised to fit the tenons on the piles.

Each pile row will be braced horizontally with a 5" by 10" yellow pine brace laid with its bottom edge at mean low water and diagonally braced with 5" by 10" yellow pine sticks extending from the ends of the horizontal braces to a mitre joint on the side of the cross-cap near the center thereof, all of this bracing will be bolted to the piles and cross-caps.

The vertical pile at the inshore end of each pile row will be chocked with a 12" by 12" stick of yellow pine extending horizontally from the inshore pile to the lower waling piece and with similar chock extending horizontally from the inshore pile to the next higher waling piece. These chocks will be toe spiked at their ends to the pile and to the waling pieces respectively.

A bracing pile will be driven at the outer end of each pile row with a slope of 8 inches horizontal and 12 inch vertical framed at the butt end so that it may bear against the underside of the bracing pile cap of 12" by 12" yellow pine extending along the inside of the top of the cross caps, at their outshore ends; this bracing pile will be bolted to the cross cap with a 1⅛" screw bolt and with a similar bolt through the horizontal brace and pile row and on each side of the same a similar bracing pile will be driven so as to head against the vertical piles on each side of the row in front of the wales. These bracing piles will be so framed as to head against the outshore side of the vertical pile and against the underside of a bracing cap about 3 feet 6 inches long fastened to the underside of the cross-cap.

The floor or deck of the platform will consist of a steel re-enforced concrete slab 10½ inches thick laid directly upon the cross-caps, thus bridging over the space between the cross-caps. The top half-inch in thickness of this slab will be pure Portland Cement to provide a wheel surface preliminary to such a time as it may be desired to lay an asphalt pavement upon the deck slab.

A backing log of 12" by 12" yellow pine will be laid upon the side ranger before described and fastened thereto with bolted dockspikes and screw-bolts.

At the outshore end of each pile row a white oak pile will be driven with a slope extending from the top of the side ranger to the bottom at a point about 3 feet outshore of the end pile to serve as a spring fender pile. This pile will be faced on the inner side of the butt so as to flare against the end pile, the side cap and end of the cross-cap and against the ranger. These fender piles will be bolted through the side ranger and side cap, and will be capped on top with a 10″ by 12″ yellow pine cap for the protection of the end grain of the pile against decay and will be chocked in between with two lines of 10″ by 10″ chocked yellow pine, one at the top of the side-ranger and one line with its bottom flush with the bottom of the side cap.

In each 10-foot bay there will be three lines of vertical chocking between the horizontal chocks just described. These fender piles and the yellow pine chocking are intended to provide a riding surface for vessels alongside as the tide rises and falls.

At intervals of 60 feet along the top of the backing log, a cast iron side butt or mooring post will be fastened and securely anchored with screwbolts and chocking to the platform structure for the mooring of steamers; and midway between the mooring of posts, cast iron cleats will be similarly secured to the backing log for the mooring of smaller vessels.

INFORMATION OBTAINED RELATIVE TO TYPES OF CONSTRUCTION, ETC., USED IN OTHER PORTS AND COMMUNITIES.

It was thought desirable in this connection to investigate the types of construction employed in the development of the waterfront in other communities and sections of this country and Canada and so the following letter was addressed to the Board of Harbor Commissioners of the following cities, and the star placed beside the cities indicates from whom replies have been received at the date of this report.

Dear Sir:

We are planning and projecting a great Marine Terminal in New York Harbor on the New Jersey side of Upper New York Bay, which, when completed, will be one of the most important terminal developments in this country.

I am very anxious to obtain information as to the most recent practice at your port, in dock, pier and wharf construction: and in types of pier-sheds, storage and factory buildings, and in harbor facilities in general.

If you will be so kind as to furnish me with any data or description which you have available, it will be greatly appreciated.

Yours very truly,

New London
*Povidence
*Cleveland
Vancouver
*Portland
*Seattle
San Francisco
*Los Angeles
Santiago
*Houston
*Beaumont
Galveston
*New Orleans
*Mobile
Jacksonville
Pensacola
Savannah
Charleston
*Baltimore
*Norfolk
Philadelphia
*Boston
*Toronto
*Quebec
*Montreal

This list includes the principal Canadian Ports, the principal ports along the Atlantic Coast, along the Gulf of Mexico, and on the Pacific Coast, and at the writing of this report many plans have been received and many constructive opinions from the leading port authorities of the country as to their local conditions and local practices. Especially valuable information has been received from Seattle, Washington; Los Angeles, Calif.; Houston, Texas; and Portland, Oregon, as well as from Baltimore and Boston, and it is expected that we will hear from many of the other port authorities. We have felt that nothing should be overlooked in the way of constructural and operating details which might add to the efficiency of the proposed Bayonne Terminal as we aim to make this terminal the last word in terminal layouts and construction.

Among the data and other information forwarded the following plans and documents were received. These have been most carefully considered and have been most valuable in assisting us, not only in determining waterfront construction types and materials, but they have also helped us materially in determining other matters in connection with this lay-out.

We are very grateful to the representatives of these cities for the courtesies extended and for the generous way in which they have complied with our requests.

Baltimore, Maryland.

Mr. H. Kent McKay, Engineer and President of the Harbor Board, Baltimore, sent us a book entitled "Baltimore Harbor," published by the Harbor Board of Baltimore. This book gives in considerable detail the design and construction of Baltimore's municipal piers. In this a statement is made relative to the moneys expended on waterfront improvements:

> "The City of Baltimore, through the Harbor Board, will have expended at the close of 1916 $2,800,000 for deepening the harbor and $9,200,000 for public wharves and docks and marginal or waterfront streets."
>
> "Prior to the great fire of 1904, the City owned but little wharf property of importance. At the present time, however, nearly six miles of municipally owned wharfage front are in a high stage of development. While the ruins of the fire were still smouldering, the City negotiated

the purchase of this property, and the Harbor Board designed and constructed a system of public wharves and docks second to none in this country. Practically all of this construction is of an absolutely permanent nature, much of it being of re-inforced concrete throughout."

When it is seen, as stated in the book, that the harbor proper is about 150 miles from the Capes where the bay enters the Atlantic Ocean, and is 14 miles from the mouth of the river, the significance of this great expenditure in this great waterfront activity on the part of Baltimore can be more thoroughly appreciated.

Los Angeles, California.

The Board of Harbor Commissioners has sent us through its president two plans of transit sheds, a plan showing details of a creosoted pile wharf, a plan showing details of typical concrete wharf, a plan showing details of concrete warehouse, copies of several photographs of these sheds, and a copy of their annual report.

Concerning waterfront improvements in Los Angeles the report referred to has this to say:

"How Los Angeles won its fight for a deep water harbor at San Pedro, how it extended its factories to the sea in order that it might legally be enabled to pour its wealth into building a great port, and how it has already voted $5,500,000 for that development has already been written into history.

"The first $3,000,000 of these bonds became available for expenditure in April, 1912, and the balance of $2,500,000 has just become available within the past few months, yet a great change in the harbor has already been brought about. Where only a few years ago was a wide stretch of mud flats in the Inner Harbor, over which the tide ebbed and flowed twice daily, there are now channels with a depth of 30 feet at low tide wharves capable of receiving and shipping hundreds of thousands of tons of commerce annually, freight sheds up to a thousand feet in length, and a hundred feet wide, paved streets and railway terminals and industries giving employment to a large number of persons;

and in addition to this, there are large acres of reclaimed tide lands and water frontage capable of development many times as great as that which has already taken place."

This report also states: "While the fame of Los Angeles is widespread because of its climatic attractions and its rapid growth in population and business, it has been comparatively little known as a sea-port, owing to the fact that it is only within recent years that Los Angeles has become a seaport. In order to acquaint the world with what Los Angeles has done, and is doing, in harbor development, and especially to place before the shipping world the facilities of the Port of Los Angeles, and the resources and commercial development of the city and its tributary territory, the Board of Harbor Commissioners published in the last year a book entitled, 'The Port of Los Angeles.' Approximately two thousand copies of this book were placed in the hands of steamship companies throughout the world, United States Consuls in foreign countries, and other persons and corporations interested in shipping. The supply of these books was exhausted soon after publication and this Board has since received many requests for copies of it.

"This book has widely advertised Los Angeles and its harbor, especially among steamship companies, and it brought forth letters from several hundred such companies representing the largest shipping concerns in the world."

Boston, Massachusetts.

Through the courtesy of Mr. Frank W. Hodgdon, engineer to the Massachusetts State Commission on Waterways and Public Lands, Boston, Massachusetts, we have received the following relative to port improvements in Boston:

"Several plans showing in detail construction of piers already erected, those under construction, and those proposed to be constructed; a very large map showing the Boston Harbor and its vicinity, this map being worked up in colors and in much detail; annual reports for the years 1913, '14, '15. From these reports it has been learned that at the beginning of the fiscal year 1913 there were appropriations at the disposal of the Directors of the Port of Boston, of $9,217,476.95—$9,000,000 from the development of the Port of Boston Loan Fund, authorized by Chapter 748 of the Acts of the year 1911, and $217,476.95 from the Commonwealth's Flats Improvement Fund, authorized by Chapter 586 of the Acts of 1910."

With this appropriation Boston is endeavoring to work out a comprehensive plan of port development that will not only efficiently and economically take care of the trans-shipment of freight, but also to hold and attract industries in and to the territory contiguous to the Port. This is plainly seen from the following statement taken from their last report:

> "During the past few years there has been a tremendous interest in the extension of port facilities. The underlying reason probably is that the nation has just begun to realize that it has entered upon the industrial export stage of development, and unless a port is able to provide sufficient articulation to traffic for the receipt of shipment of raw materials, and efficient exchange of produce between factories and terminals, it will be handicapped in the struggle for industrial supremacy. The motto of the successful trader of today, whether he be manufacturer or merchant must be *economy* and *despatch*.. If he is deprived of these, his chances of success are destroyed or at least jeopardized.
>
> "The functions of the Boston Board of Port Directors are twofold, commercial and industrial. The commercial function has to do with the trans-shipment in the Port of Boston, between rail and water lines, and between the water lines, of freight not destined to, or originating in, the Port of Boston itself. This commercial phase of port work is simply a matter of efficient connection between transportation lines at the water edge. The industrial function deals particularly with local freight destined to or originating in the territory under the jurisdiction of the port and contributory to it. This is a much more complex matter, and its solution demands direct transportation connections at an equitable flat rate between the local industrial distributing houses and the wharves; sufficient warehouses and storage facilities on the water front, where local freight may be assembled in carload lots, and where after unloading freight may remain for assortment and local distribution. While local pride is greatly concerned in the commercial function of the home port, taken as a whole, ocean-borne commerce is of much less advantage to the port city than is popularly thought. A large investment is necessary to create facilities to accommodate this commerce, and a large percentage of the cargoes is distributed by rail directly to interior points, with small direct benefit to the port of entry. On the other hand, the business and financial progress of the port of Boston, and, indeed, all of New England, has much more at stake in the development of the industrial function, which has to do with making manufacturing and commerce easier and more profitable."

The following from the 1916 report is of interest to show how some of the ports are not only actively engaged in real improvement work but to what extent they talk about these improvements:

"By act of the General Court the Directors of the port are authorized to do publicity work to advertise the Port of Boston and to bring the importance of the Port and its function in the business life of New England to the knowledge of the people. The directors have obeyed this law in various ways:

"By preparing newspaper articles, interviews, etc.

"By lectures and appearance at public meetings, etc.

"By illustrated booklet entitled, 'The Port of Boston, U. S. A.,' prepared by the directors and widely distributed at the Panama-Pacific Exposition from February to December, 1915. Motion pictures of the Port of Boston have also been exhibited at the San Francisco Fair and at other places during that period."

This booklet and the motion pictures are reported to have been in constant service during the Exposition, and to have met with favor.

The Legislature of Massachusetts passed a law which was approved June 1st, 1916, which is described as "An Act to abolish the Board of Harbor and Land Commissioners and the Directors of the Port of Boston and to establish the Massachusetts Commission on Waterways and Public Lands." This Commission takes over all the rights, powers and duties formerly conferred and imposed by law on the Board of Harbor and Land Commissioners and on the Directors of the Port of Boston.

Seattle, Washington.

From Robert Bridges, President of the Port of Seattle Commission, we have received the following significant communication:

"Your communication of August 1st is at hand and we are very glad indeed to learn of the development of a great thoroughly modern terminal at Bayonne. We desire at this time to earnestly solicit the transmittal of all published documents which may issue in your community respecting such development for both the Port of Seattle Commission and the Seattle Public Library.

"Under separate cover we are sending you a nearly complete file of this body, which you will discover is just completing a system of improvements requiring $6,000,000 of public funds, including piers, storage and warehouses, cold storage plants, grain elevators, fishing boat basins, handling cranes, etc. I attach hereto a memorandum of Mr. Hamilton Higday, traffic manager, respecting certain improvements already constructed from an operating standpoint.

"I sincerely trust that the development in Bayonne will be the last word in a public terminal and that it will be an advance step over the famous development of the Bush property on Long Island."

The documents received from Seattle include several booklets describing the various different improvements, several plans and reports. The following statement taken from the 1915 report:

> "The Port Commission having spent the year 1912 in planning, in 1913 began in orderly, efficient fashion to carry out the wharf construction called for in the official comprehensive scheme of harbor improvement, adopted by vote of the people."

indicates how recent improvements Mr. Bridges referred to are and the thoroughness with which they are taking up the development of their waterfront, and on commenting on what has already been done this reporth as this to say:

> "These public port utilities belong to the public. They are publicly owned. The indirect earnings are many times the collection of money entered upon ledgers of the wharves and warehouses."

New Orleans, La.

Mr. J. Deveraux O'Reilly, Engineer to the Board of Commissioners of the Port of New Orleans, has sent us plans and specifications of their most recent wharf construction in New Orleans.

From a recent government report of the Department of Commerce entitled "Ports of the United States" we learn that "New Orleans ranked second among the ports of the country in value of its coastwide and local trade. Its chief distinction as a port, however, is the fact that it has attained a high degree of success in the public ownership and operation of port facilities." This development of public ownership of the waterfront in New

Orleans began in 1890 when the state Legislature created the Board of Commissioners of the Port of New Orleans, or the Dock Board as it is generally called. In 1900 this Board was given the following powers:

"(1) To regulate the commerce and traffic of the port and harbor of New Orleans in such a manner as may in their judgment, be best for its maintenance and development.

"(2) To enjoy all rights, powers and immunities incident to corporations.

"(3) To take charge of and administer to public wharves and lands of the ports of New Orleans.

"(4) To construct new wharves where necessary and to erect sheds on the wharves and landings to protect merchandise in transit.

"(5) To maintain sufficient depth of water.

"(6) To collect dockage charges and harbor fees at specified rates (see list of charges on Page 241) and such charges of for use on wharf sheds as will not exceed cost.

"(7) To acquire by purchase or appropriation any property, wharves or lands necessary for the benefit of the commerce of the port; the common council of the city of New Orleans to provide for the payment out of funds under its control, provided the price to be paid is satisfactory to the city council.

"And in 1910 the Dock Board was given power to erect and operate warehouses and other structures necessary to the commerce of the Port of New Orleans, with the right of eminent domain in connection therewith, with authority to issue bonds therefore, payable out of net revenues and with power to fix charges and to issue warehouse receipts, either negotiable or non-negotiable."

Thus it will be seen that New Orleans has proceeded and is proceeding in the assumption that port terminal facilities consist of three essentials; that is, dock facilities, switching facilities, and warehousing faciltes are necessary to the expeditious and economical handling of commerce and that all three should be operated in conjunction and under the same character of neutral control, and the facts show that she has been amply rewarded for spending millions of dollars in port improvements based on this theory. So well has this work been done, and so much has it been put before the public, that New Orleans is now looked upon as a model for municipal waterfront ownership and operations, and yet all of this work is of comparatively recent development.

Toronto, Canada.

Mr. James R. Wainwright. Assistant Chief Engineer of the Toronto Harbor Commissioners has sent us a number of plans showing details of their waterfront construction, a very large map in colors, showing the relation of the harbor to the city, and a number of booklets descriptive of what his commission is doing. From these booklets we learn that it was only in 1911 that a body was created under the name of the Toronto Harbor Commissioners and was placed in control of Toronto's harbor and waterfront with a primary object of interesting industries intending to locate in Canada, in Toronto and provide them with every facility required by modern maufacturing conditions. For this purpose the Commissioners have been devoting their energies particularly to the reclamation of the district of hitherto waste land and the installation in this district of proper railway siding facilities, docks served by deep water, on Toronto Harbor. The entire work as planned is estimated to cost $24,190,000 and it is expected that it will be completed by 1921. It will be seen from this that Toronto is working on a definite and comprehensize plan of development and from the way she is going about it gives every indication that this plan will be carried out and that in carrying it out everyone will kown about it. The descriptive matter submitted to us is very handsomely and artistically arranged and any one looking this over cannot help being deeply impressed with what Toronto is doing and plans to do.

Quebec, Canada.

Mr. D. C. L'Esperance, Chairman of the Quebec Harbor Commission, has forwarded us copies of their last annual report and these reports show that this commission is actively engaged in improving the Quebec waterfront and is now expending on this work approximately $2,000,000 a year, and that these improvements consist of dredging, bulkheading, grain elevators, car ferry terminals, railway yards, etc.

Portland, Oregon.

Mr. G. B. Hegardt, Engineer to the Commission of Public Docks of the City of Portland, has sent us a number of blue prints covering the construction details of municipal docks 1 and 2 of that city and of the one-story warehouse constructed in the rear of dock No. 1, and shows that these structures were all built in the last two years, and are typical of the most recent and modern practice of that port. We also have a number of annual reports of the Portland Commission and from these we learn that this commission was created in 1910, and that one of the first steps taken was to have a comprehensive plan prepared for the development of the waterfront as well as plans for the most economical use of $2,500,000 which was available for construction and sites. The comprehensive plan that was finally worked up called for the expenditure of $30,000,000.

Houston, Texas.

Mr. E. E. Sands, Harbor Engineer to the Board of Harbor Commissioners complied with our request by sending us several detailed drawings of their municipal wharf construction as shown in wharf No. 4. The Harbor Department of Houston is of recent creation, it having been organized in December, 1913. The amount of money appropriated for waterfront improvements and the construction of the ship canal has been $5,777,866. The Harbor Board plans to operate its own system of tracks to connect all the terminals on the waterfront with the existing Belt Line which now circles the city and which is privately owned.

Providence, Rhode Island.

Mr. William D. Bullock, Chief Engineer of the Rhode Island State Harbor Improvement Commission, Providence, Rhode Island, has sent us several plans of a pier, bulkhead, and pier sheds constructed by the State of Providence. The Rhole Island

Harbor Commission was created by act of the Legislature in 1910 for the purpose of improving and developing shore property for public piers at Providence, East Providence and Pawtucket. This commission has control only of that section of the waterfront which the State has acquired and improved and for the development of which the Legislature appropriated $1,000,000. The work of this commission merely supplements that of the city government.

Bayonne's Comparative Advantageous Location.

In discussing what other water front cities are doing in respect to developing their water fronts, their relative locations to the nearest path of foreign commerce and domestic coastal trade compared to the site selected for the Bayonne Terminal is very significant. The impression forced upon us is that Bayonne is making practically nothing of her most advantageous location.

The Bayonne site is but 15 miles from the ocean, a very much shorter distance than practically all of the cities that are spending large sums of money on waterfront development and on port organization. This can be readily seen when this distance is compared with the following distances from the ocean, gulf or open bay.

New Orleans is 106 miles from the Gulf of Mexico.
Philadelphia is 105 miles from the ocean.
Baltimore is 151 miles from the ocean.
Hartford is 52 miles from the ocean.
Houston is 50 miles.
Jacksonville 27½ miles.
Mobile 30 miles.
Port Arthur, Texas, about 17 miles.
Portland, Oregon, 112 miles.
Richmond 104 miles.
Sacramento 111 miles.
Savannah 26 miles.
Washington 195 miles.
Wilmington, Delaware, 82 miles.
Wilmington, N. C., 30 miles.

Necessary Facilities.

The general plan and cartoon which accompany this report indicate a completed terminal development. We have given consideration to what work should be done and to what facilities should be provided in the first instance in order to start and make operating the development. We have termed this the "Primary Installation" and we have developed and estimated on five different forms of Primary Installations. The plans of these Primary Installations accompany this report and are drawings Nos. 12 to 16 inclusive. They are specifically described in the latter part of this report and the summary and estimates therefor are included in the synopsis of the report.

It will be seen by reference to these detailed descriptions that the following are necessary:

Extensive railroad facilities, bulkhead sheds, storage sheds and ferry terminals, and after a most thorough and careful investigation we are of the opinion that no Primary Installation without these facilities can be successful.

Necessity for Extensive Railroad Facilities.

Where large volumes of freight are handled, there will be the most attractive locality for industries to locate because of the better and quicker shipments and deliveries which can be made and at a reduced expense. The railroad freight yard established here with direct connection to all of the railroads terminating in the New Jersey portion of the harbor would give manufacturers located nearby as well as in the terminal the advantage of several hours over terminals located in other parts in New York Harbor to which and from which lighterage must be performed with the railroads. This is an item of vital importance. It is well known that delays occur in receiving and shipping freight at practically all of the terminals in the harbor which would not occur at a point having direct rail connection to the trunk lines and receiving and distributing large volumes of freight.

The site selected for the Bayonne Terminal would have direct rail connection to all of the so-called New Jersey railroads, that is, the Pennsylvania Railroad, the Lehigh Valley Railroad, the Central Railroad of New Jersey, the Baltimore and Ohio Railroad, the Erie Railroad, the Delaware, Lackawanna and Western Railroad, the New York, Susquehanna and Western Railroad, the West Shore Railroad, and the New York, Ontario and Western Railroad. How this will be so is shown on map No. 17 and which has been especially prepared to accompany this report.

This map shows the location of the proposed terminal and has marked on it the principal classification yards of the New Jersey roads in the vicinity of tide water. These yards are used for assemblying and classifying New York Freight, both steamship and railroad freight in both directions, and freight to and from the proposed Bayonne Terminal would be classified and assembled at these yards.

This map shows the routes from the Bayonne Terminal to these yards and that they are the following distances from it, indicating clearly how very close this site is to all of these great trunk line railroads and how easily and quickly freight will be despatched to them from the Bayonne Terminal.

Bayonne Terminal to D. L. & W. R. R., Secaucus Yard	8.6 miles.
Bayonne Terminal to Erie R. R., Croxton Yard	6.4 miles.
Bayonne Terminal to C. R. R. of N. J., Elizabeth Yard	5.2 miles.
Bayonne Terminal to P. R., Waverly Yard	7.0 miles.
Bayonne Terminal to L. V. R. R., East Oak Island Yard	4.0 miles.
Bayonne Terminal to L. C. R. R., West Oak Island Yard	5.0 miles.
Bayonne Terminal N. Y. C. R. R., Weehawken Yard	9.0 miles.
Bayonne Terminal to N. Y. C. R. R., 60th St. Yard	9.0 mile.

It will be noted that the Bayonne Terminal will have direct connection with every railroad terminating in the Port of New York except the New York, New Haven and Hartford Railroad and that because the Connecting Railroad now nearing completion will enable this railroad to transfer their cars to Bay Ridge, Brooklyn, just across the harbor from the Bayonne Terminal, this railroad will be very convenient to the Bayonne Terminal.

That such railroad facilities will be a distinct asset to Bayonne in general and to those factories already located there as well as serve to attract industries to the proposed development is shown by the following letter which was received from one of the largest shippers now located in Bayonne.

"The writer noticed with interest the work which has been done so far towards the location of a large marine terminal at Bayonne, and notices especially the statement that in connection with this terminal there would in all probability be a sorting yard, or a transfer station for the prompt and proper handling of freight in less than carload lots.

"The location of such a transfer station would be invaluable to this development, and would not only attract many manufacturers to Bayonne, but would serve splendidly the needs of those manufacturers already located there, being alike of great value to the large as well as the smaller manufacturer. Larger manufacturers with their individual sidings, of course, are well served so far as their incoming materials are concerned. Their approximate needs are known considerably in advance of the use of raw materials, and for this reason they can place there orders well in advance of their requirements and usually their raw product is received in car shipments with little or no delay. Very few manufacturers, however, sell their product in car lots, and the bulk of the individual shipments therefore are made in what are known as less than car shipments.

"Competition among manufacturers is not alone the price of the article, but the service which is rendered in the prompt filling of orders, and the promptness does not stop at the mere delivery to the transportation companies of the material, but finishes only when the goods are received by the buyer.

"Shipments on the lines of railroads on which a manufacturer's plant is located usually go through with reasonable despatch, but when the ultimate destination of the goods is on a different railroad then the trouble of the shipper begins, due to the manner in which the railroad companies divide the freight rate.

"All freight rates whether in less or in full carloads are divided between the railroads on the basis of the miles hauled, therefore if a rate to a given point be 20c per cwt. and each railroad company has hauled the freight an equal distance, each railroad will therefore receive 10c per cwt., on this basis the railroad receiving the freight is naturally anxious to haul that freight just as many miles as he reasonably can, so as to get a greater proportion of the rate, therefore, if a manufacturer located on the Lehigh Valley R. R. at Bayonne desires to ship a carload of his wares to a customer located at Perth Amboy, this carload instead of being immediately transferred to the Central R. R. of N. J. in Bayonne is taken to Bound Brook and there delivered to the Central R. R. of N. J. and then hauled all the way back to within a few miles of Bayonne, and transferred to the line running from Elizabethport to Perth Amboy.

"The same method is pursued in the shipment of less than carload lots, with this exception, that the shipper loads his less than car lots in what are known as house cars, which when loaded are sent to the nearest transfer station, where goods are taken out of this car and placed in another car moving to Bound Brook, and as soon as that car has weight enough it moves. At Bound Brook the goods are then taken out of the car, and as soon as the car in which they are placed has enough goods for Elizabethport it goes forward to Elizabethport, where the goods are there again taken out and transferred to a car which will ultimately reach Perth Amboy, therefore, a shipment, such as this, which ought to take forty-eight hours at the outside, would naturally take two or three weeks to arrive at destination. Hence the Bayonne manufacturer has been compelled to truck all of his less than car shipments to the roads on which is located the point of destination. In case of the Perth Amboy shipment he would deliver these goods by truck to the Central R. R. of N. J. in case of a Rahway shipment he would deliver these goods to the Penn. R. R., and in the case of a shipment to a point on the New York Central R. R. he would deliver to the New York Central, etc.

"The location of a less than carload transfer station at the new transportation terminal would mean that he could load in a house car freight for miscellaneous destinations, for all roads entering New York Harbor, and for the sum of approximately $3.00 or whatever the normal switching charge would be this car could be transferred to the terminal and the goods transferred from this car to cars for the various roads by which they would have to move. This would decrease naturally the elapsed time in the delivery of his material. and he would save whatever it now costs him to truck these goods to the various railroads, less the switching charge above refered to.

"To put this in a concrete way, if a manufacturer had 10 shipments of 1,000 lbs. each, for ten different transportation companies his cost of cartage based at 10c per cwt. would be $10.00: for a switching charge of $3.00 he could effect the same ten deliveries thus a net saving for him of $7.00.

"Trusting that this feature of the terminal will not be lost sight of, and will be included as one of the main features, I am

Yours very truly,

And so in any primary installation it is deemed desirable to provide transfer bridges for handling railroad cars to and from car floats and to provide a sufficient railroad yard with transfer platforms, local freight houses, and team tracks.

Bulkhead Sheds.

It is essential for ships with miscellaneous cargo to unload that cargo and to receive that cargo along side of adequate bulkhead sheds. It cannot be expected that the cargo will be removd by land carrier or by harbor truck immediately it is lifted out of the hull of the ship, and therefore some provision must me made for the protection of this cargo during the interval of its unloading from the ship and its being taken away to its destination. Similarly cargo for a ship must be assembled prior to the arrival of the ship in order that there may be no delay. Ships' charters are very expensive and lay-days must be avoided, and, therefore, facilities must be provided at the docks for the storage of cargo while it is being assembled.

Bulkhead sheds, therefore, are necessary, and the installations which we have planned provide adequate bulkhead sheds wherever the ships with miscellaneous cargo are likely to dock.

The bulkhead sheds are built directly back from the stringpiece, are of ample height, at least 24 feet under the roof girders, are provided with many doors and are equipped with cargo hoists or cargo brackets, which have proven so efficient for the handling of cargo between the dock and the ship. This method of loading and unloading ships with mixed miscellaneous cargo has proven exceedingly efficient and economical at the Port of New York.

The sheds themselves are designed to be of light material, and no attempt has been made to construct the sides or roof of fire proof materials. Experience has shown that if a fire gets properly started in a pier or bulkhead shed in the cargo, that fireproofing is inadequate and ineffective; but we have designed a sprinkler system and included it in our estimates, covering every square foot of the bulkhead area. Experience with sprinklers in piers is that they are the most efficient means of protection and are well worth the cost of installation. In addition to this the insurance companies place a considerable lower rate of insurance where sprinklers are provided.

The deck of the bulkhead sheds is of re-inforced concrete supported by creosoted piles and is practically indestructible. It is easily cleaned and its maintenance cost is very slight.

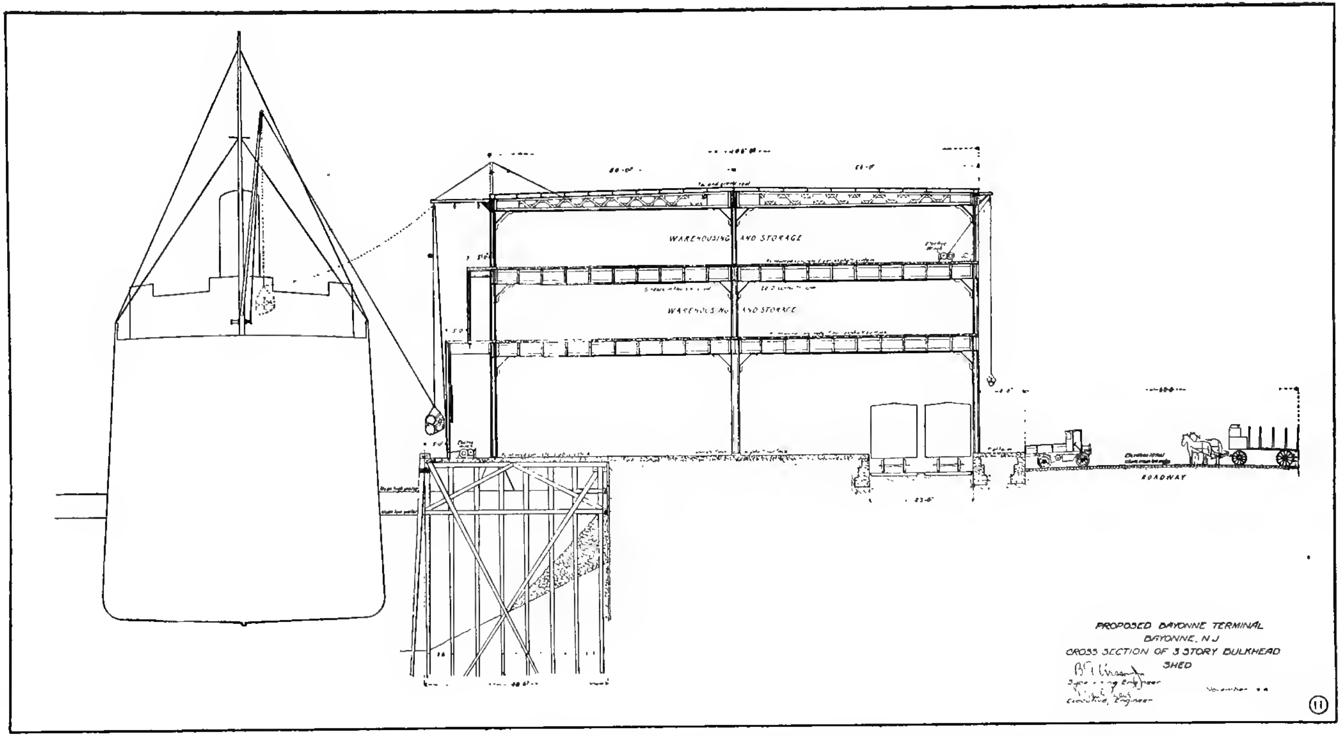
Storage Sheds.

Every 600 feet along the bulkhead platform there is placed over the single story bulkhead shed a two-story storage building for the storage of cargo in transit. Experience has shown that it is necessary to provide for the storage of freight in addition to the short time storage which can be accommodated in the bulkhead sheds. These storage buildings are similar generally in design to the bulkhead sheds, with many doors, and fully equipped with sprinklers, with no attempt at fire proofing the sides or the roof, and with cargo hoists or brackets to facilitate the handling of cargo.

A notable departure has been made in the design of these sheds by setting back the shed on the second floor five feet from the line of the bulkhead shed, and by setting back the third story shed five feet from the second story shed, so that there will be a platform to land cargo on and to receive cargo from, and for operators. This practice, while it is not generally in practice in this country, is extensively used abroad. Many of the storehouses in London, for instance, are built in this manner.

The cross section of the three story shed is shown on drawing

No. 11 accompanying this report and this is the type which is contemplated in Primary Installation No. 5. The lower floor will be for the protection of commodities in transit where they can be handled directly between ships and trucks and railroad cars. The second and third stories extend over the railroad tracks and are contemplated for storage and warehousing. The ten-foot platform to the rear will make it possible to handle commodities between the warehousing and storage floors and railroad cars or trucks without their coming into the pier sheds at all. This is a rather novel design and is believed will effect economies in storage over those at present existing at the port. Commodities can be taken from ships and stored and then loaded into railroad cars, or into trucks without the necessity of any intermediate drayage, and without having to pass through a congested pier or bulkhead shed.



Cross Section of 3-Story Bulkhead Shed Recommended

Vehicular and Passenger Ferry.

A careful investigation shows that a terminal of the character proposed must have direct and reasonable access to Manhattan, for truck loads of merchandise that must go to and come from that borough of New York City.

Ships or freight trains coming to the Port of New York have freight of such quantity and of such character for Manhattan that in order to attract them to any terminal outside of Manhattan it will be necessary to have a direct connection from the terminal or its vicinity to Manhattan so that this freight can be easily transferred there. In order also to have as much of a manufacturing field as possible to draw from to locate in this terminal it is also necessary to have direct access to Manhattan for easily, quickly, and cheaply distributing freight to that point.

All of the successful marine and industrial terminals in the Port of New York have at hand or near at hand easy and direct vehicular connections with Manhattan and consider such connections vital to their success.

The Degnon Terminal, which is located in the Long Island City section of Queens Borough, New York City, began building operations in 1914 and since which time or in less than three years has erected nine factory buildings and has four other such buildings under construction providing a total floor area of 1,800,000 sq. ft. has this to say on the very first page of its prospectus:

> "The one predominant feature of this large acreage before it had been transformed into an Industrial Terminal was its proximity to, and the fact that it enjoyed a physical connection via the Queensboro Bridge with the centre of Manhattan Island,* * *"

And in discussing this phase of the situation Mr. A. A. Stuart, the secretary of the Degnon Terminal, writes us that "there are some industrial enterprises which do not market their products in New York or the vicinity thereof, and to such, a means of communicating with Manhattan Island would be of no advantage. However, a large majority of manufacturers market a large part of their output in New York, and it would, therefore, be absolutely essential that such enterprises should have available means of quick access to New York for vehicular transportation, and I should regard it as very essential to the quick development of your city to provide a means whereby vehicles could reach Manhattan Island quickly."

The American Dock Company, which is located at Tomkinsville, Staten Island, Borough of Richmond, New York, and which now has buildings providing a storage capacity of 9,000,000 sq. ft. and a Pier and Bulkhead area of 500,000 sq. ft. features on the first page of its prospectus in describing its location the inception of the ferry from New York to Staten Island and the establishment of the present service between those points and on the next page is a picture of a Staten Island Ferry Boat and the Staten Island Ferry Terminal.

Mr. A. B. Pouch, the president of the American Dock Company, in writing us of that company's terminal states that "The ferry facilities are absolutely essential to the class of business conducted at this terminal, and, without the ferry, it could not be operated."

So important does the Bush Terminal Company, located at South Brooklyn, Borough of Brooklyn, New York City, consider its ferry connection with Manhattan that this facility is the first one mentioned in its prospectus. Under the caption "A New Freight City" the prospectus starts in by saying:

> **"At the lower edge of Manhattan, immediately adjoining the ferry house, which has for years been familiar by name, at least, to every resident through its cognomen, "South Ferry," is a more modern and spacious structure, the Thirty-ninth Street Ferry, across which, on fast modern ferryboats, one reaches South Brooklyn in an interesting seventeen minutes sail."**

Again in the back of the Bush Terminal Company's booklet is a list of questions usually asked by visitors to the plant collected from the company's experience of several years together with the answers. The very first question visitors ask is "How does one reach your plant from New York City?" and the answer is, "It can be reached quickly and conveniently via the following routes: 1st, ferry from foot of Whitehall Street, near the Battery, to 39th Street, Brooklyn, in 17 minutes." Note again how highly important this greatest and most modern of terminals considers a direct vehicular and passenger ferry with Manhattan.

Mr. Irving T. Bush, president of the Bush Terminal Company, in writing on the subject of terminals in New York Harbor some four years ago, had the following to say relative to the necessity of providing an easy and direct vehicular connection from such a terminal to Manhattan.

> "My experience in our Brooklyn development teaches me that it is almost impossible to persuade the agents of freight steamers to discharge their vessels at any point in New York Harbor unless there is direct and reasonable access to Manhattan, for truck loads of merchandise which must go to that Borough. The reason for this is that almost every cargo which comes carries a large percentage of coarse freight which can be discharged anywhere, where lighter facilities exist, but there is also a small percentage of high-class freight which, while forming a small part of the cargo, pays a higher rate for carriage. This small percentage of freight is destined for use in Manhattan, and the agents of the vessel are unwilling to discharge the cargo at a point which does not have the facilities for getting this part of the freight promptly to Manhattan. Therefore, in the final analysis, the location of the discharging and loading berth is determined by a small percentage of the cargo."

And Mr. Bush in commenting on the proposed Bayonne Terminal writes us as follows:

"I do not believe that the kind of development which Bayonne will desire on her waterfront can be successfully brought about without a ferry connection with Manhattan. A development caring for only some of the cheaper raw products could be successfully undertaken without a ferry, but such a development would not, I believe suit the people of Bayonne."

The Hoboken Factory Terminal, at Hoboken, Hudson County, New Jersey, is the only factory terminal located in the New Jersey part of the Port of New York, and without its direct vehicular connection with Manhattan it would not have been the great success it is.

Inasmuch as the Hoboken Terminal is located on the same side of the port as the Bayonne Terminal will be, it is particularly interesting to note the progress of this terminal. In reference to this Mr. W B. Wilson, the assistant general manager, writes us that:

"Building 'A' which was completed three years ago, is a ten-story building. All the other buildings are twelve stories and basement. The number of square feet in each can be readily computed by you from the floor area indicated in the blue print.

"In addition to building 'A,' building 'D' is also erected and occupied, having been completed on December 1st, 1916. This will leave only buildings 'B' and 'C' to be constructed.

"Building 'A' was completed at the time when the details of the new tariff act was being worked out in Congress, a time when it was very difficult to induce any manufacturers to make any move until they knew how their business would be affected by the tariff. In spite of this fact 195,000 sq. ft. out of a total of 200,000 sq. ft. in this building were leased within eleven months of completion, to a miscellaneous lot of manufacturers.

"Building 'D' was leased entire to the Remington Arms Union Metallic Cartridge Company two months in advance of completion.

"Building 'F' was begun without any special tenant in view but leased entire to one tenant before the work on the foundation had fairly begun.

"An agreement for lease had been executed for building 'E' before any building had been begun or any contract for this work let.

"Our rental price for building 'A' is 30c a sq. ft. with 15% additional for the top floor. The rental for building 'D,' 'E,' and 'F' was practically on the same basis with a reduction because of the fact that the tenant in each of these buildings is required to man the elevators and otherwise operate the buildings.

"On September 1st, we shall advance our rate to 35c a sq. ft. with 15% additional for the top floor of building 'A,' some space of which will be vacant on December 1st.

"As you will see by the folders these buildings adjoin the 14th Street Ferry, Hoboken, which runs to 23d Street, New York."

Fom this it will be seen what great progress the Hoboken Factory Terminal is making, and Mr. Wilson, in discussing some of the factors that have made this success possible, advises us that: "This company certainly does consider the nearness of the Hoboken Factory Terminal to New York City a most valuable asset and that available ferry facilities are most essential. Without the above combination we would have been very seriously handicapped in our development."

Thus it will be seen that all of these successful terminals located in different parts of the port have, in addition to their rail and water facilities—and they have them, to more or less extent a direct and easy vehicular connection with Manhattan. And that their operators feel that such a facility has played a very important part in their successful development and that these experienced operators of successful terminals in the Port of New York all feel that such a connection between the proposd Bayonne Terminal and Manhattan is a necessity if the character of terminal selected for Bayonne is to be a success.

It is quite well known that New York City leads in population and commerce, but that this city leads in industry is a revelation to most people. The following statement taken from the last United States Census Report on Manufactures conclusively shows this to be the case however, And when it is considered that two thirds of the plants and employees of New York City are in Manhattan and that most of the commerce and at least one-half of the population is there too, it will be seen that any marine terminal and industrial city in the Port of New York in order to have the fullest measure of success must have a direct and easy vehicular connection with Manhattan, because no matter how good and efficient the rail and water facilities are, there will also be a good deal of trucking to that point.

"New York City is not only the leading city and the commercial center of the United States, but also the industrial metropolis, holding first place in the total value of manufactured products as well as in many individual industries. In 1909 the population of New York City was practically equal to that of the State of Ohio and exceeded only by Pennsylvania, Illinois, and New York itself, but the value of its manufactured products exceed that reported by any state except Pennsylvania and New York. This predominance in manufactures is closely connected with the abundant supply of labor its large immigration population being in particular an influential factor in causing manufacturers to locate there. New York City is the chief center of trade between the United States and Europe and also one of the principal distributing points for domestic trade. This commercial importance has also contributed to the high rank of the city in manufacturing industries and to making New York the financial center of the United States, thereby rendering it easy to obtain capital for the establishment and extension of such industries."

In commenting on New York City's standing and importance as a manufacturing center, the Honorable Marcus M. Marks, President of the Borough of Manhattan, stated in an address delivered on October 21, 1916, that:

> "New York has 38,000 factories, with almost $2,000,000,000 of capital, turning out annually products valued at $3,000,000,000 and employing 810,000 persons receiving $540,000,000 annually in salaries and wages. Few people know that one-tenth of the manufactures of the United States are made in New York City."

It is necessary to the success of any terminal in the Port of New York providing industrial facilities of the dimensions contemplated to have direct and easy vehicular connection with Manhattan. It is also equally essential that such a terminal located in a community as small in population as Bayonne is, should have an easy, direct, and cheap means of passenger communication with Manhattan so that an abundant and diversified supply of labor can be obtained at any time under all conditions. A ferry from this site to Manhattan will help to insure this.

Many manufacturing plants originally located in very much larger idustrial cities than Bayonne have found is necessary to move to Manhattan or to a locality convenient thereto in order that their labor needs could be adequately and continuously supplied.

Bayonne at the present time does not have direct and easy vehicular connection with Manhattan. It is now necessary to truck about five miles through Jersey City over badly paved, narrow, and congested surface car streets to the nearest ferries that operate from that city to Manhattan. This trip takes approximately one hour for motor driven trucks and about two and one half hours for horse drawn trucks, and exclusive of ferry fares, it costs about three dollars to operate a truck to Jersey City and return. Under these conditions it is very difficult to attract industries to Bayonne that do any considerable amount of trucking to New York, and yet it is because of the necessity of reaching Manhattan with their product that many industries prefer a location in New York or in its immediate vicinity.

Moreover, inasmuch as a direct ferry from Bayonne to Manhattan would effect a great saving in time as well as in expense.

it would materially benefit those concerns already located in Bayonne at the present time who have to do trucking to New York.

The following letter was addressed to practically all of the manufacturing and trucking concerns located in Bayonne, and the replies received, extracts from some of which are also given here and which are typical, indicate very clearly that a ferry direct to Manhattan would materially benefit their business and consequently Bayonne.

"As you are perhaps aware, there is in contemplation the establishment of a marine terminal, similar to the Bush Terminal in South Brooklyn, on the New York Bay shore of Bayonne, and that included in this project is a ferry to some point in lower Manhattan, the Bayonne terminal of which, as now planned, would be at the end of about 45th Street, extended a mile into the bay.

"Would you be kind enough to advise us whether or not you would make use of such a facility if it were established, giving in detail the present number of vehicular trips your concern is now making daily in each direction between Bayonne and New York, and as to the character of vehicles, that is whether horse drawn or motor driven? If you happen to be one of those concerns that let out their trucking to some express or trucking concern, will you state how may trips per day in each direction these trucking concerns make for you, and who they are. Will you also state if such a ferry were established whether or not your trucking btween Bayonne and New York would increase and to what extent.

"It is our understanding that it takes approximately an hour for a motor truck to go from Bayonne to New York at the present time and from two to three hours for a horse drawn truck to make the same journey. It will take about twenty minutes for a ferry to run from the contemplated terminus in Bayonne to lower Manhattan. Under present conditions, a ferry must in any event be used to reach New York, and it is presumed, therefore, that under these conditions you would be glad to take a ferry direct from Bayonne.

"Please be kind enough to co-operate by giving this information in as much detail as possible and at your earliest opportunity."

Extracts from Typical Replies from Bayonne Manufacturers Relative to a Bayonne-Manhattan Ferry.

"We go to New York with our motor truck about once a day. These trips take at least an hour each way for a motor truck and three hours for a team. Providing it took the same length of time on a ferry, it would be much cheaper to us considering the present rate of gas and you would save in wear and tear on motor truck, as the trucking streets to Jersey City are in very bad shape.

"If such a ferry was established, we would probably go to New York oftener than we do at the present time."

"We would be very much interested and would welcome a ferry in the approximate location mentioned in your letter, as it would materially decrease the expense incident to the trucking of material from Bayonne to New York City. Our truckage to New York City varies with the seasons in our business. At no time, however, have we less than 2 six-ton, 1 four-ton, and 1 two-ton trucks. Just at present we are trucking to New York City daily 3 six-ton, 2 four-ton, and 1 two-ton motor trucks. In October and November this would increase to 6 six-ton, 3 four-ton, and 1 two-ton trucks.

"It is difficult to state whether the establishment of a ferry such as you mention would increase trucking of our company to New York City—generally speaking, cheaper, quicker and better transportation facilities naturally increase the tonage hauled."

"We are now using two automobile trucks that make almost daily trips to New York and in the fall we will, no doubt, use an additional automobile truck. A ferry to New York would be of great help to us and would, no doubt, go far towards increasing our Metropolitan business.

"At the present time we probably average three loads of lumber for New York a week, motor driven. However, if such a ferry as is in contemplation was in operation we would probably use same a great deal as it would give us an opportunity of delivering material in New York at a very much more advantage, as far as time and expense is concerned, than we now have. We should be very glad indeed to see such a ferry in operation."

"If a ferry was established from the end of about 45th Street, Bayonne, to some point in lower Manhattan, it certainly would be used by us when going to and from New York City. If the proposed ferry was established no doubt our trucking to Manhattan would increase 100%."

"At the present time we are sending our wagon to New York on an average of once a week. We believe that if there were ferry connections, we would increase this to at least five trips a week."

"At the present time, we are making from one to two trips a day with our 5-ton motor truck, and in addition to that service, we very often employ outside trucks.

"We are unable to say as to the amount of business we might have in the future, but no doubt same would increase, and I can safely say that the ferry would be patronized in all trips."

"We are at present sending two double horse trucks to New York daily, and a motor truck has been under consideration. We should very likely make use of the proposed Bayonne-New York ferry, if it were established, owing to the saving in time and expense, and it is quite possible that our trucking business might be increased under these circumstances."

"Our trucking at the present time amounts to about a truck every other day to New York or Brooklyn and the average size of the truck is about 3 or 4 tons, and usually is a two-horse truck and sometimes an automobile of the same capacity.

"It would seem to us as though the proposed ferry would greatly reduce the time and cost of trucking, and if this is the case, our trucking would correspondingly be increased, but, of course, it would be impossible to give any definite figures on this."

It is important that the Bayonne terminal of a Bayonne-Manhattan ferry be conveniently located and as near Manhattan as possible so that the operating distance and consequently the running time may be as short as possible. In order that as much business as possible can be attracted, the ferry operating expenses should be kept down to a minimum, and it is believed that a ferry terminal located on this site will fulfill these requirements.

It is estimated that the ferry running time from this site to lower Manhattan should not be more than twenty minutes, as the distance is only four miles. The ferry route from Staten Island to the Battery, Manhattan, is somewhat over five miles, and the average running time is twenty-two minutes, and the ferry route from 39th Street, Brooklyn, to the Battery, Manhattan, is about three and a half miles, the average running time being seventeen minutes.

There is a very large population within ten minutes walk of the proposed site, and as the scheduled running time by train and ferry to lower Manhattan from the nearest railroad station in this locality is twenty-four minutes, and as it takes about an hour by trolley and ferry or by trolley and the Hudson Tubes to reach lower Manhattan, and as the ferry fare would no doubt be less than the train or trolley, such a ferry would probably be a money and time saver for a large number of Bayonne people who go to lower Manhattan daily. It is, therefore, entirely conceivable that this direct, faster, and cheaper route will be patronized by these people. And in addition to this, the trolley extension provided to connect the trolley system in Bayonne with the ferry terminal will also make this ferry available to all of Bayonne.

As this site is located close to the limits of Bayonne nearest Manhattan, a ferry terminal located thereon will be in the path of all vehicles going in that direction, and at a point where this traffic is greatest, and so they can be picked up and carried on from here without the necessity of doubling on their route.

Bayonne is not making the most of her near Manhattan location at the present time, nor will she ever do so until a direct, easy, and cheap vehicular and passenger connection with that point is provided for. The proposed development on New York Bay gives Bayonne an opportunity to have provided for her such a connection. And it is only through some such comprehensive development as is proposed that a ferry terminal can be located in this convenient section because so much dredging is necessary to make the water deep enough so that a ferry can be operated reasonably close to the shore line and present built-up section of Bayonne, that the cost of making provision for a ferry alone would be prohibitive.

From every conceivable angle, therefore, it seems desirable that a ferry terminal be initially included in any development planned on New York Bay, and so such a facility has been provided for in our preliminary installation.

It is recognized that docking and railroad facilities are essential to the character of development contemplated. It is not so well known, however, that an easy and direct vehicular connection with Manhattan is equally essential to the kind of terminal proposed, if it is to have the greatest measure of success. It is also thought that a ferry in operation between Bayonne and New York will be a material help in establishing a highway bridge over Newark Bay, because this combination will materially shorten the distance between those communities on the westerly side of Newark Bay and Manhattan. It was deemed desirable, therefore, to go into this phase of the subject in more detail and at greater length than might appear necessary on first considration.

Prospects for the Success of the Bayonne Terminal.

In advocating a terminal for Bayonne and the character of terminal recommended, its immediate and future success has been carefully considered. Its success depends on present demands for such facilities in the port of New York, whether or not such demands will continue, whether or not the business desired can be attracted to such a terminal in Bayonne, and whether or not this, once obtained can be held.

The need for terminal organization in New York Harbor has never been felt more acutely than it is at the present time. Steamship companies have the greatest difficulty in procuring dockage space for unloading cargo and for receiving cargo. This is so obvious, and has been stated so often, and by so many in a position to know that it seems unnecessary to burden the Commission or this report with a mass of evidence to support this fact.

Prbably the best evidence that can be submitted in this connection is that many ships which would naturally dock here and which desire accommodations at the Port of New York are now going to outlying ports such as Philadelphia, Boston, Baltimore, and New London, simply because they cannot find accommodations at the Port of New York and the activity in recent years on the part of many nearby ports in spending millions of dollars in increasing their facilities is predicated almost entirely on the fact that port terminal facilities are lacking in the port of New York and that if these cities provide accommodation for ships, a good deal of the business that would naturally go to New York must necessarily, because of the lack of facilities there, go to these other cities where facilities can be found. In this connection, the Merchants' Association of New York, an association composed of more than five thousand of New York's leading merchants, states that "the commerce of the port has far outgrown its facilities. The city is constantly compelled to deny application for docking facilities, thus driving commerce to other ports."

The lack of terminal facilities in the port was accentuated during the hearing held by the New York Harbor Line Board of the United States Army Engineers, New York City, only a few weeks ago. This hearing was held to consider an application made by private interests to have the New York Harbor Lines changed so that a large artificial island could be made on what is known as the Middle Grounds or the "Eastern Anchorage" in New York Bay, the applicants proposing to develop this island with docks, railroad yards, warehouses, etc., the entire project to cost forty million dollars. Those behind this proposition had made an exhaustive study of the necessities of the port along these lines, and although considerable opposition developed at the hearing on the ground that the proposed island would be an obstacle to harbor traffic, that it would create strong currents in the tide, would reduce the tidal prism, would confine floating ice in winter in the upper bay, would have a bad effect on sewerage problems, would spoil the beauty of the bay, and that it would do away with valuable anchorage grounds, etc., it was conceded by all of those in attendance that there was great lack of dockage and terminal facilities and among those present were the representatives of many of the large shipping interests and port authorities.

As further instance as to the needs of the port along these lines, it may be stated that terminal facilities are immediately taken as fast as they can be provided by the city of New York at very high rates, and on long term leases. This indicates that those leasing these facilities feel that they are at such a premium that those available had better be tied up for as long a time as possible.

Improvement by Private Capital.

Quotation from 1913 Annual Report of Department of Docks and Ferries, City of New York:

"The large appropriations authorized by the city for port development and the outlay which will be required in the future has led to the adoption of a policy whereby much needed waterfront improvements can be carried on by the employment of private capital, leases being given for a sufficient term of years on such terms as will amortize the original expenditure and at the termination of which the improved property reverts to the city free of charge. Between Rector and Carlisle streets, North River, Piers Old 8, 9, 10 and 11 and the adjacent bulkhead have been permitted by the owners and occupants to deteriorate so that they were practically unfit for commercial use. The widened exterior street under the control of the Department has been extended southerly to this point and the traffic which thus converged at this narrow portion of the street blocked the traffic to a very serious extent. An arrangement has been made with the Lehigh Valley Railroad Company whereby the city is to acquire the property and lease it for a term of 41 years and the company is to reimburse the city for the cost of acquisition and to remove the old structures, to widen the street to its full width and construct modern concrete piers and sheds, all at the expense of the Company. At any time after the end of ten years the city may terminate the lease upon payment to the company of the investment, less the amortized portion of the expenditure. This improvement will be completed at once."

"The New York, New Haven and Hartfort Railroad Company have entered into a somewhat similar contract on the East River, and in addition have surrendered part of their leaseholds and concentrated their railroad business in the vicinity of Clinton and Montgomery Streets. Negotiations are now pending with the Delaware, Lackawanna and Western Railroad Company at Pier 26, East River, and the Erie Bailroad Company at Chambers and Duane streets. It is estimated that these improvements represent an investment of $5,500,000 private capital, from which the city will receive immediate benefit and which will ultimately revert to the city without cost."

That Bayonne is in the center of the Port of New York is clearly shown on Map 17 accompanying this report. The site selected for the proposed terminal is as near to the ocean as are the other terminals in the port of New York. The Bayonne site is fifteen miles from the ocean, the Bush Terminal is fourteen miles from the ocean, and the new terminal which the City of New York is developing at 44th Street, North River, is twenty-one miles from the ocean.

In addition to this there is a railroad bounding the site connecting directly with all of the trunk line railroads terminating in the Port of New York, except one. The site selected is close to deep water, is undeveloped, and is large enough to be developed in such a manner that it will have better facilities than any existing terminal in the port of New York.

The Central Mercantile Association of New York City has recently completed an industrial survey of New York and found that "In peace time, a scheduled ocean going vessel leaves the harbor every two hours and forty minutes to carry its share of New York's two billion dollars a year ocean trade. From 1898 to 1913 the foreign commerce of New York increased one hundred and thirty-one per cent until fifty-eight per cent in value of all American exports passed by the State of Liberty," and the Statue of Liberty is only a little over a mile from the site of the proposed terminal.

The lack of any proper terminal organization at New York stands out most prominently, and the high terminal costs, particularly to the railroads, are being felt to such an extent that efforts are now being made towards some system of joint operation of terminals. This is well indicated by the organization of the American Terminals Company which has recently been organized by the National City Bank, co-operating with one of the important engineering concerns, and they have set aside a large sum of money for the express purpose of studying the New York Port problem and developing a way in which terminal costs may be reduced.

In view of the fact that practically all of the other terminals in New York are separated from the trunk line railroads, freight which comes and goes to these railroads from these terminals has to be lightered. This lighterage is an artificial cost, therefore which would not be necessary if the terminals were located with direct rail access to the main lines. This lighterage cost would be eliminated as would also be the great delays incidental thereto at the Bayonne Terminal because of the direct railroad connection referred to, and consequently the terminal costs, at that terminal should be lower than at other terminals, and the time required to make shipments decrease and so this terminal cannot help but attract business.

That a direct rail connection with New Jersey railroads is a great economic asset is clearly seen when it is considered that out of a total daily average of 225 freight cars received from and forwarded to the Bush Terminal in South Brooklyn all but 54 or 72% are from railroads terminating in New Jersey. This not only indicates to what extent terminals located on the New York side of the port have to float railroad freight, but it also indicates that most railroad freight comes to New York through New Jersey.

The success that the contemplated terminal should have is clearly indicated in the success that the Bush Terminal has had. This latter terminal being one which has practically all of the facilities planned for the Bayonne Terminal, on a scale large enough to be useful as a comparison, and if the Bush Terminal located as it is, separated by water and subject to severe waves and winds which from time to time endanger shipping on the Brooklyn side of the upper bay, separated from water from practically all of the trunk line railroads, it would seem reasonable to expect that the Bayonne Terminal can be more successful.

The Bush Terminal comprises approximately 200 acres, approximately 191 of which are already developed. This development includes at the present time, 10 loft buildings and 2 more under construction; 2 industrial lofts; 38 1-story warehouses; three 4-story warehouses; and six 7-story and basement warehouses or a total of 128 buildings. Four of the loft buildings are 600 by 75 feet; four are 700 by 75 feet; two are 440 by 150; and two are 150 by 150 feet; and they are all constructed of re-inforced concrete throughout. These loft buildings provide about four million square feet of rentable warehouse area which is approximately all rented. The 1-story warehouses are 100 by 75 feet; the 4 and 5-story warehouses are 200 by 67 feet; and the 6 and 7-story warehouses vary in their dimensions. Some of these are of brick and some are of re-inforced concrete, and comprise over twenty-five million cubic feet of storage space. There are 8 piers, all but one of which are over 1,200 feet long and all of these piers are being used to their greatest capacity. A railroad yard covers approximately 15 acres, has a car capacity of 1,000 cars, and has approximately 15 miles of trackage.

The Bush Terminal Company has not been established a great many years. The Bush Terminal Company was organized in 1902. In 1904 this company purchased the property controlled by the Bush Company Ltd., which at that time comprised 2 piers, one float bridge, a railroad yard, and several warehouses. It was not until 1905 that the first factory building was commenced. There are now approximately 25,000 people employed in these industrial buildings, and about 3,000 people on the piers, or a total of 28,000. It has been said that approximately 75% of the employees live within walking distance of the terminal. There are nearly 300 different manufacturing concerns having regular storage space there.

From this it will be seen that in a very short period of time practically all of the facilities in the Bush Terminal have been developed, and that the terminal itself is now approaching its limit of development.

Despite the efforts of other American ports to attract commerce and the efforts other European ports are making in this direction, there can be no question that the Port of New York will continue to hold its commercial supremacy. This is substantiated by the following statement taken from the report of the New York State Commission to investigate port conditions and pier extensions in New York Harbor, made by its chairman, the Honorable R. A. C. Smith, Commissioner of Docks and Ferries, the City of New York, August 30th, 1915:

> "Statistics of the value of foreign trade of the next five leading United States seaports fail to disclose anything menacing to the port of New York. New York seems to be abundantly able to hold her own. It is in imports, of course, that New York signally outranks all other American ports. Over one billion dollars is now the annual value of the imports at the port of New York, while only at the Port of Boston does the annual value of imports exceed one hundred and forty million dollars, as will be shown in the statistics of growth year by year, although not revealed in the decade periods.
>
> "New York's stability as a great port is shown in the evenness of its imports and exports. Although the value of the latter does not reach that of imports, in bulk which is the essential consideration with shipping, the exports largely exceed the imports *The port of New York is notable, above its rival sister ports, for its superior ability to furnish return cargoes to vessels bringing it imports.* This is a consideration that is sure to make New York more and more attractive to the ships of the world that seek to carry on the foreign commerce of the United States.
>
> "During the year of 1880 there was a great gain in the foreign commerce of the United States, and in all of the ports with the single exception of Galveston. This increase amounted to $350,000,000, an increase of one-third over the previous year. The gain at the port of New York was more than $241,000,000, an increase slightly more than one-third. But during the succeeding twenty years the value of the foreign commerce of the port of New York did not average any higher than it attained during the single year of 1880 It was that long period of stagnation that gave rise to the alarm of New Yorkers, and led to the widespread discussion of its "loss of foreign commerce and the appointment by Governor Black, in 1898, of the New York Commerce Commission, to study the subject of New York's commerce, the cause of its

decline and the means for its revival." That commission filed its final report with Governor Roosevelt in 1900, before which time, however, New York had taken on a new growth, and, during the years that succeeded, its foreign commerce has grown, proportionately more rapidly than that of all of the Atlantic Ports of the United States combined, and even slightly more proportionately, than the foreign commerce of the entire Nation has grown.

"More latterly—indeed, during the whole of the past fifteen years—it has not been so much the loss of its commerce that the Port of New York had to fear, as its ability to take care of that offering.

"The rapid growth of ocean steamships, of which the largest, longest and deepest that are built come to the Port of New York, has of recent years entailed large appropriations, in the construction of which the City of New York is at present engaged.

"A study of the percentage of growth of the value of the foreign trade, should shed some light upon the natural query as to whether or not any of the other ports are growing more rapidly than the ports of New York. Elsewhere will be found the tables showing the value of imports and exports at the leading foreign ports, by years, from 1890 to 1912, inclusive. The following table shows the values by ten-year periods, and for the last two years:

Average Values of Imports and Exports of Merchandise at Leading Ports of the World.

Port.	Period.	Average Values of			Average Per Cent of Increase over Decrease		
		Imports.	Exports.	Total.	Imports.	Exports.	Total.
New York	1891-1900	$490,142,932	$397,291,510	$887,434,442	...	...	...
London..	1890-1899	722,268,462	402,397.617	1,124,566,078	...	...	...
Liverpool.	1890-1899	509,938,390	472,505,650	982,444,050	....	...	...
Hamburg.	1891-1900	408,389,677	335,081,888	743.471.566	...	...	...
New York	1901-1910	697,726,032	575,271,730	1,272,997.762	42.3	44.8	43.4
London..	1900-1909	901,154,806	504.715.689	1,405,870,498	24.7	25.4	24.9
Liverpool.	1900-1909	674,313,821	633,705,637	1,308,019.459	31.4	34.1	32.1
Hamburg.	1901-1910	696,843,806	556,203,170	1,253,646,986	70.6	66.1	68.1
New York	1911-1913	986,542,546	840,815,693	1,809,358,239	38.8	46.1	42.1
London..	1910-1912	1,131,612,202	504,715,689	1,804,210,251	25.5	33.2	28.1
Liverpool.	1910-1912	826,390,075	877,654.839	1,704,044,914	22.5	38.4	30.2
Hamburg.	1911-1912	1,029,737,767	787.745.748	1,817,483,515	47.7	41.5	44.9

The foregoing table serves but to give additional emphasis to the closeness of these four great ports in the race for world supremacy. A study of the table clearly indicates that the advantage seems to be strongly with Hamburg. She has reached from fourth to first position. In this showing the port of New York ranks second, London a very close third, and Liverpool a hundred million of dollars in the rear, on the total average value of her imports and exports. Moreover, Hamburg's percentage of growth quite overshadowed that of the other ports for the period of 1891 to 1900, and it substantially leads them during the short period covered by the last section of the table—with exception of New York, whose percentage of increase was only slightly less than that of Hamburg.

"The figures of the tonnage vessels that entered these four ports will be interesting by way of further comparison:

Average Net Tonnage of Vessels That Entered Leading Ports of the World In Foreign Trade.

Port.	Period.			Average net Tonnage.	Average percentage of Increase.
New York	1901-1910	over	1891-1900	10,516,817	45.2
London	1901-1910	"	1891-1900	11,006,968	27.1
Liverpool	1901-1910	"	1891-1900	7,654,646	44.1
Hamburg	1900-1909	"	1890-1899	10,147,372	79.4
New York	1911-1913	"	1901-1910	13,855,625	31.7
London	1911-1912	"	1901-1910	11,386,982	3.4
Liverpool	1911-1912	"	1901-1910	7,570,386	1.1*
Hamburg	1910-1912	"	1900-1909	12,272,212	20.9

"If the net tonnage of vessels entering the ports in foreign trade is the better indication of their relative importance in foreign trade, the showing in the last table is more favorable to the Port of New York than the one based upon the values of imports of merchandise. While Hamburg's growth in tonnage during the decade between 1901 and 1910 over the preceding decade was 79.4 per cent. and covering a greater number of years, may be regarded as a clearer indication of trend, its advance in the subsequent three years was but one-fifth as rapid as during the decade named.

"Liverpool's growth during the 1901-1910 decade is striking, considering the effect of the Manchester ship canal upon the maritime business of the Port of Liverpool. And it should be said of Liverpool that, although the construction of the Manchester canal has not seemed to seriously affect its 'maritime business, nevertheless, it has to an extent' doubtless checked the rapidity of Liverpool's progress. The Manchester canal was completed in November, 1893, a fact deserving of consideration in any review of the development of Liverpool's maritime progress during the past twenty years. The showing of London and of Liverpool for the two years 1911 and 1912 as compared with the preceding decade, does not indicate as rapid progress during the current decade as during 1901 to 1910. New York shows up the best of all, although both New York and Hamburg's averages cover three years, while those of London and Liverpool cover but two.

"These studies would seem to indicate that, so far as the United States is concerned, the Port of New York's commercial and maritime

---

*Decline.

> supremacy is unassailable. If it has reason for the slightest apprehension it would seem to lie in the growth of foreign commerce of the two leading gulf ports. Unless some totally unlooked for new development completely revolutionizes the trends of the international traffic, and until industries in the South have been far more extensively diversified than at present, any apprehension from that section would seem to be groundless—at least, seemingly, quite "beyond our time." Nor is there reason to believe that the Panama canal will be so extremely advantageous to gulf ports as to seriously imperil the commercial and maritime interests of Atlantic Ports."

In the opinion of those qualified to judge, there can be no question that this country's export business will continue to grow after the European War, for after this war is over, Europe will be busy repaiiring itself and looking toward its own regeneration, and the markets of the world, which have been dependent on Europe for a large part of their commodities, must seek these commodities elsewhere, and this country is in a splendid position to supply them.

American shipyards are working to their fullest capacity, and the number of ships now under consideration compares very favorably with the number being turned out in Great Britain.

New York will continue to be the principal port of export in this country, for in addition to the great railroads terminating there, the Great Erie Barge Canal, which the State of New York has been constructing for several years at an expenditure of $135,000,000, exclusive of terminals, will soon be completed. This canal runs from the Great Lakes to the Hudson River and thence to New York Harbor.

This great expenditure of money will be of little avail, however, without sufficient terminal facilities to take care of the great traffic that is expected to come through the canal to New York. Realizing this, the amount set aside by the State of New York for terminal construction alone in greater New York is $9,740,000. Bayonne has a great opportunity of taking advantage of this great expenditure for canal re-construction on the part of New York, by including in the proposed Bayonne Terminal those facilities demanded by the kind of traffic that will use the canal. And those have been considered.

Relative to the present great demand for docking facilities in New York Harbor, there appeared the following in the New

York Herald (a publication considered an authority on shipping) for September 10th, 1916.

> "The rapidity with which the more valuable water front below the Brooklyn Bridge is passing into strong hands for permanent uses makes the available supply scarcer and scarcer; also strengthens the belief that this class of property is in strong demand, more particularly when it is borne in mind that with the completion of the new marginal and connecting railways, cargo canal and freight distribution yards, and new city docks South Brooklyn shippers will have many advantages not now possessed by them.
>
> "Steamships now must wait several days while anchored in the upper bay before being assigned to a pier or dock, then submit to the high wharfage charges demanded, which in many instances run from $150 to $200 a day before being in a position to discharge their cargoes.
>
> "The existing water front congestion is accentuated by the removal to New York City of many foreign shipping and importing lines, including Norwegian, Spanish, Dutch, Belgian and South American. Many of these ships are being changed to American registry. Much of this change undoubtedly is a result of war conditions, but shipping men are inclined to believe that a considerable part of this foreign shipping trade will be held in New York after the war in locations where they have been firmly established for several years and have either purchased or leased docks, covered piers and shipping terminals.
>
> "The biggest factor in the increased demand for water front property in South Brooklyn has been the incorporation of a large number of new American Ship owning companies since the start of the war. Enormous prices have been paid by these American ship owners for steamers to form a nucleus of their future fleets of freight carriers.
>
> "Another factor in the South Brooklyn demand is the inquiry from Pacific coast shippers, particularly the lumber interests who are shipping through the Panama Canal and the Great Lakes in the largest ships now obtainable. These interests find the Brooklyn water front particularly adaptable because of the provisions made for the distribution of their cargoes to scows and lighters."

If this is the situation in South Brooklyn, where there are no direct connections to the transcontinental railroad systems, how much greater will be the demand for such facilities that would be provided at the Bayonne Terminal, where direct rail connections can be effected.

In the Bayonne development an effort should be made to obtain direct benefits from the commerce which it provides for. The terminal should be more than merely a port of entry and a port of exit. It has been stated by an eminent authority "that probably not more than 5% of the foreign trade of the port belongs to New York City at the present time, while 95% belongs to the country outside of the city."

Such a terminal as that contemplated would seek to develop the interland close by, and attract manufactories from inland cities. Indeed the general tendency now is for manufacturerers to locate near the seaboard, particularly in view of the enormous increase in exports as a result of the conditions in Europe. This condition will not cease, according to the best of minds on the subject, at the termination of the war, but the United States will develop greatly its export trade.

The report of the Chamber of Commerce of the State of New York for the fiscal year ending June 30th, 1915, shows that our exports over imports was $1,094,419,600.

In speaking of after the war conditions and of the future of the export business of the United States, Dr. E. E. Pratt, Chief of the Federal Bureau of Foreign and Domestic Commerce, has stated:

> "I have yet to find the practical man largely engaged in exporting who believes that he will do less business abroad at the conclusion of the European War than he did before. Man after man, manufacturer after manufacturer, exporter after exporter, with whom I have talked on this subject, state in words almost alike in answer to the question, "Will you be able to hold this new trade?" "I do not expect to hold it all, but I expect to hold a very large part of it."

And at another time this same authority, Dr. Pratt, said:

> "I believe it is absurd to think that European nations will be able to do more after the war than they did before the war. I believe that domestic wants will have to be filled before the European nations can seriously undertake foreign trade. No matter how much they may want it, no matter how much they may need it, they will first have to set their own houses in order. Because, as a matter of fact, we make a great mistake in supposing that foreign trade is something distant and separate from domestic trade. As a matter of fact, the goods and products which are exported come from the same fields, from the same warehouses, from the same factories, as the goods which are used in domestic trade, and it is only after the domestic wants have been filled and after production has gotten up to a point beyond those for domestic needs can any nation engage successfully in foreign trade."

The Merchants' Association of New York on November 10th, 1916, or on the very day that this report is submitted, reports as follows on these conditions:

> "There is now coming another shifting of this trans-shipment centre. As it was transferred from Italy to Northern Europe, and then to England by wars of conquest, now this great business of trans-shipment is moving peacefully to another world port, that of New York.
>
> "It is not sufficient to have this opportunity offered to this Port of New York, but provision must now be made to receive it and retain it. This business cannot be held today by warships as in the past but only by offering superior facilities, such as the rapid and economical discharging and reloading of vessels, holding sheds and storage warehouses and those features which will attract commerce."

Control of Waterfront and Improvements Thereon.

The replies we have received from our letter to other American municipalities relative to the construction, control, etc., of their waterfronts, indicates conclusively that the tendency of this country at the present time is at least to have the waterfront owned and improved by the municipality.

The policy of New York City since 1871, when the Board of Docks was organized and given jurisdiction over the waterfront, has been gradually to municipalize the terminals as regards ownership. The waterfront properties which were originally the property of the State had been granted to private interests and it was realized that this policy was not for the best interest of the community, and so the City of New York has been buying back its waterfront.

This particularly applies to the North River, where the city now owns most of the waterfront south of 60th Street. The city has also acquired properties on the East River and on New York Bay. The policy of the City of New York has been generally to develop its waterfront by building substantial and well designed piers, but the city of New York has lost the direct control of a considerable part of its waterfront by the executions of long term leases to private interests.

The New York City waterfront, which is owned by the city, and which the city has improved, cannot at the present time be duplicated for two hundred million dollars. Certain of New

York City's dock investments must necessarily be for the public well-fare, and not paying-investments. There is no so-called open pier in New York, that is where anyone may come to discharge cargo or to receive cargo upon notice to the dock master that pays more than its up-keep, as the legal rates for this kind of wharfage are very low.

Municipal ownership of waterfront facilities has become the policy of the older European Ports. This has developed when it was seen that the growth of the port was restricted by private ownership and the rates which private capital demanded for use of the facilities. London, the greatest port in the world for many years, saw its commerce gradually being absorbed by other ports which had undertaken municipal ownership, but it was not until 1908 that the Port of London authority was appointed by an act of Parliament. This was the result of the report of the Royal Commission appointed in 1902 to study the practice in other ports. Prior to 1908 the development of the harbor facilities was under the control of private companies who owned and operated the docks and warehouses. The principal ones were the London and India Dock Company, the Surrey Commercial Dock Company, and the Millwall Dock Company.

Under the various controls, public and private, there was a lack of co-operation and the development of the harbor facilities became inadequate and the commerce of the port suffered.

In order to obtain full control it was necessary to take over the private corporations and for this purpose and for the purposes of the improvement of the harbor the Port of London Authority was authorized to issue port stock up to £27,657,156 or approximately $131,371,491.

Estimates of Cost.

A reference to the plan attached to this report and to the cartoon will show the facilities that are contemplated in the completed terminal; the transfer bridges, the railroad yards, the classification platforms, the ferry house, with its over head trolley from Center Street, the warehouse, apartment houses, cold storage houses, factory buildings, administration buildings, grain elevators, coaling station, freight houses, drive ways, etc. It will be observed that every building is directly on a railroad siding and that the great railroad yard is located where it can receive and classify freight to and from the facilities provided in the terminal.

The character of the primary installation—that is, the facilities which should be provided at first to be added to as the demands require, has been the subject of careful thought and study.

Any form of primary installation must include the following:

A substantial bulkhead to retain the materials dredged from the channels suitable for making fill.

The reclamation of a great peninsula extending from the present shore line out into the Bay.

Bulkhead platforms for docking ships and handling cargo.

Bulkhead sheds for the protection of cargo.

Warehousing accommodations for the storage of freight in transit.

Adequate channels dredged to provide access to all of the docking facilities.

Railroad connections to all bulkhead sheds and warehouses.

Terminal for ferry service for the transportation of passengers and trucks between the Terminal and Manhattan.

Transfer bridges for handling railroad cars coming from and going to railroads and terminals in the harbor which have not direct rail connection to the Terminal.

Railroad yard with facilities for classifying and assemblying freight and making up trains.

A freight house for local freight.

The above must be provided in order to make a proper operating unit, and the serious question to be decided is in what amount and quantity they should be provided in the primary installation.

A large amount of dredging must be done in the channel approaches, both to the east and to the west of the pierhead line adopted by the Federal Government, in the channels adjacent to the bulkhead platforms, and a large amount of reclamation must be done in the complete installation. It has been decided that in any installation it would be wise to bulkhead around the entire peninsula and make use of all the dredged material that will make good filling in the reclamation.

In the estimates that are given below it is assumed that the pierhead line adopted by the Federal Government remains as it now is and that the Federal Government will dredge from the existing channels into this pierhead line, and that the quantities given are for the dredging inshore of this Federal pierhead line.

In two of the primary installations shown below the exterior line of the terminal is on the west of the pierhead line established by the State of New Jersey, and this line is some 2,200 feet inshore of the pierhead line adopted by the Federal Government, and if it is decided to proceed with either of these two, it would be proper to request that the pierhead line of the Federal Government be receded to agree with the pierhead line adopted by the State, and that the Govrnment should provide channels from the present main channels into the pierhead line at its new location.

In all of the estimates for dredging given below it is provided that the mud blanket overlying the sand shall not be used for reclamation, but shall be loaded into scows and disposed of at sea according to law.

In the plans of the primary installations referred to, it will be observed that it will be possible to divide up the facilities provided and to assign them, if desirable, under individual and independent leases to private corporations.

Five primary installations have been carefully considered and estimated and are given below in detail.

PRIMARY INSTALLATION No. 1.

DESCRIPTION.

Channel 35 feet deep, 250 feet bottom width, on the north side of the peninsula dredged from the pierhead line adopted by the Federal Government to the westerly end of the northerly slip.

Channel 35 feet deep, 250 feet bottom width, on the south side of the peninsula dredged from the pierhead line adopted by the Federal Government to the westerly end of the southerly slip.

11,780 lineal feet of timber bulkhead with riprap built around the peninsula to retain the filling 40 feet inshore of the line of the finished bulkhead platform, the outshore end being just to the west of the established bulkhead line.

2,500 lineal feet of bulkhead platform on the westerly end of the northerly slip.

2,000 feet of one-story bulkhead shed 100 feet wide giving an area of 200,000 square feet.

600 feet of second and third floor storage sheds built on top of the bulkhead shed providing 111,000 square feet, or 1,554,000 cubic feet of storage capacity.

A temporary ferry terminal at the westerly end of the northerly slip.

Three transfer slips and bridges at the northerly side of the peninsula near the established bulkhead line.

A railroad yard to support the transfer bridges having a capacity of 136 cars.

A railroad yard with facilities for classifying and assemblying freight with a capacity of 814 cars.

Railroad tracks leading to the bulkhead sheds and storage sheds.

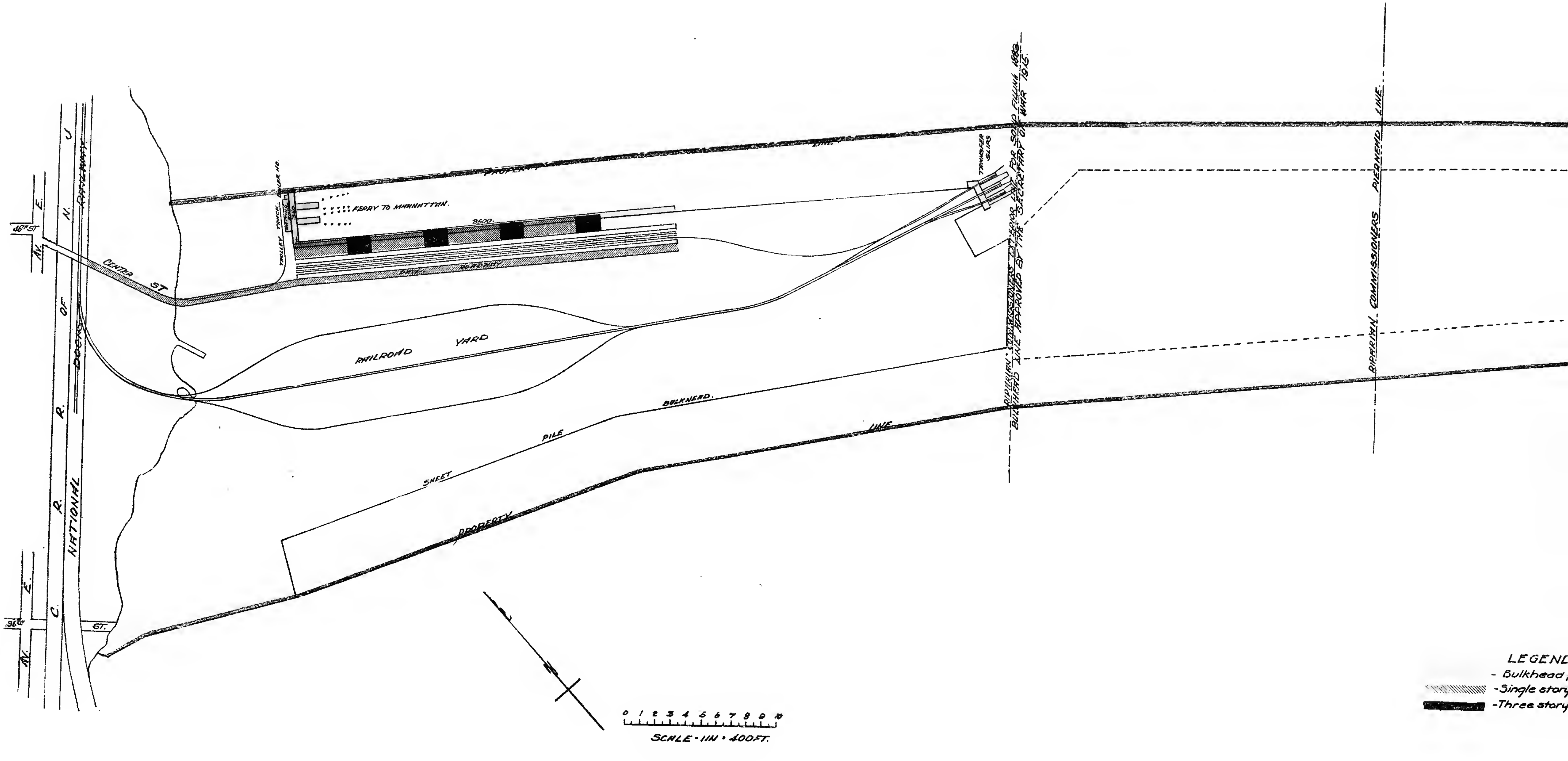
Paving to accommodate trucks to and from facilities provided.

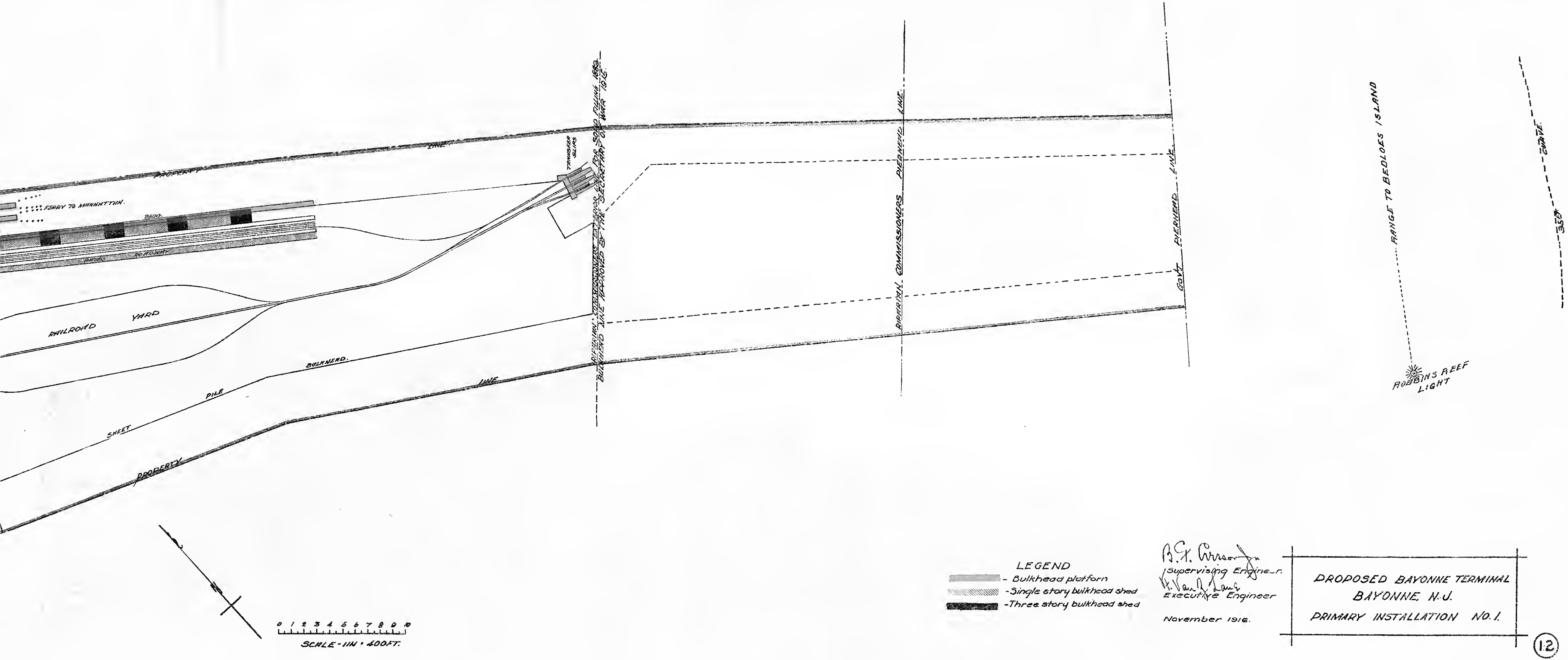
Automatic sprinklers in bulkhead sheds and storage sheds.

Cargo handling appliances.

Freight house for local freight.

In general this No. 1 primary installation contemplates the reclamation of the main peninsula, the dredging of channels, the creation of a limited amount of docking facilities, and the


46th ST
AV. E
C. R. R. OF N. J.
NATIONAL DOCKS RAILWAY
CENTER ST
36th ST
AV. E
TROLLEY TRACK
FERRY TO MANHATTAN.
2500.
PROPERTY LINE
ROADWAY
RAILROAD YARD
TRANSFER SLIPS
SHEET PILE BULKHEAD.
PROPERTY LINE.
RIPARIAN COMMISSIONERS EXTERIOR LINE FOR SOLID FILLING 1883
BULKHEAD LINE APPROVED BY THE SECRETARY OF WAR 1915.
RIPARIAN COMMISSIONERS PIERHEAD LINE.
0 1 2 3 4 5 6 7 8 9 10
SCALE - 1 IN = 400 FT.
LEGEND
- Bulkhead
-Single story
-Three story



B. F. Cresson Jr.
Supervising Engineer.
H. Van R. Lane
Executive Engineer

November 1916.

PROPOSED BAYONNE TERMINAL
BAYONNE, N.J.
PRIMARY INSTALLATION NO. 1.

⑫

location of the ferry terminal at the inshore end of the northerly slip as near as possible to the present activities of the city of Bayonne.

The facilities will provide a dockage for about 4 modern steamships, in addition to lighters, barges, etc.

The reclamation will amount to 228 acres.

The railroad yard will be sufficient to handle a large volume of freight from other parts of the harbor. This will be to the great advantage of this locality as by reason of the large amount of freight received and delivered, much quicker rail shipments between this terminal and the hinterland will be possible.

ESTIMATE FOR PRIMARY INSTALLATION NO. 1.

Mud dredging in the north and south channels west of the Pierhead Line adopted by the Federal Government loaded into scows and disposed of at sea. 2,310,127 cu. yds. @ 10¢	$ 231,012.70
Sand dredging in the north and south channels to the west of the Pierhead Line adopted by the Federal Government pumped behind the bulkhead. 2,316,289 cu. yds. @ 13¢	301,117.57
Hard pan dredging in the north and south channels to the west of the Pierhead Line adopted by the Federal Government pumped behind the bulkhead. 1,593,159 cu. yds. @ 35¢	557,605.65
Note: Hard pan consists of sand, clay and boulders and is referred to in the records of the Passaic Valley Sewerage Commissioners as "cemented triassic formation."	
Total dredging, 6,219,575 cu. yds. costing	$1,089,735.92
3,909,448 cu. yds. are available for filling.	

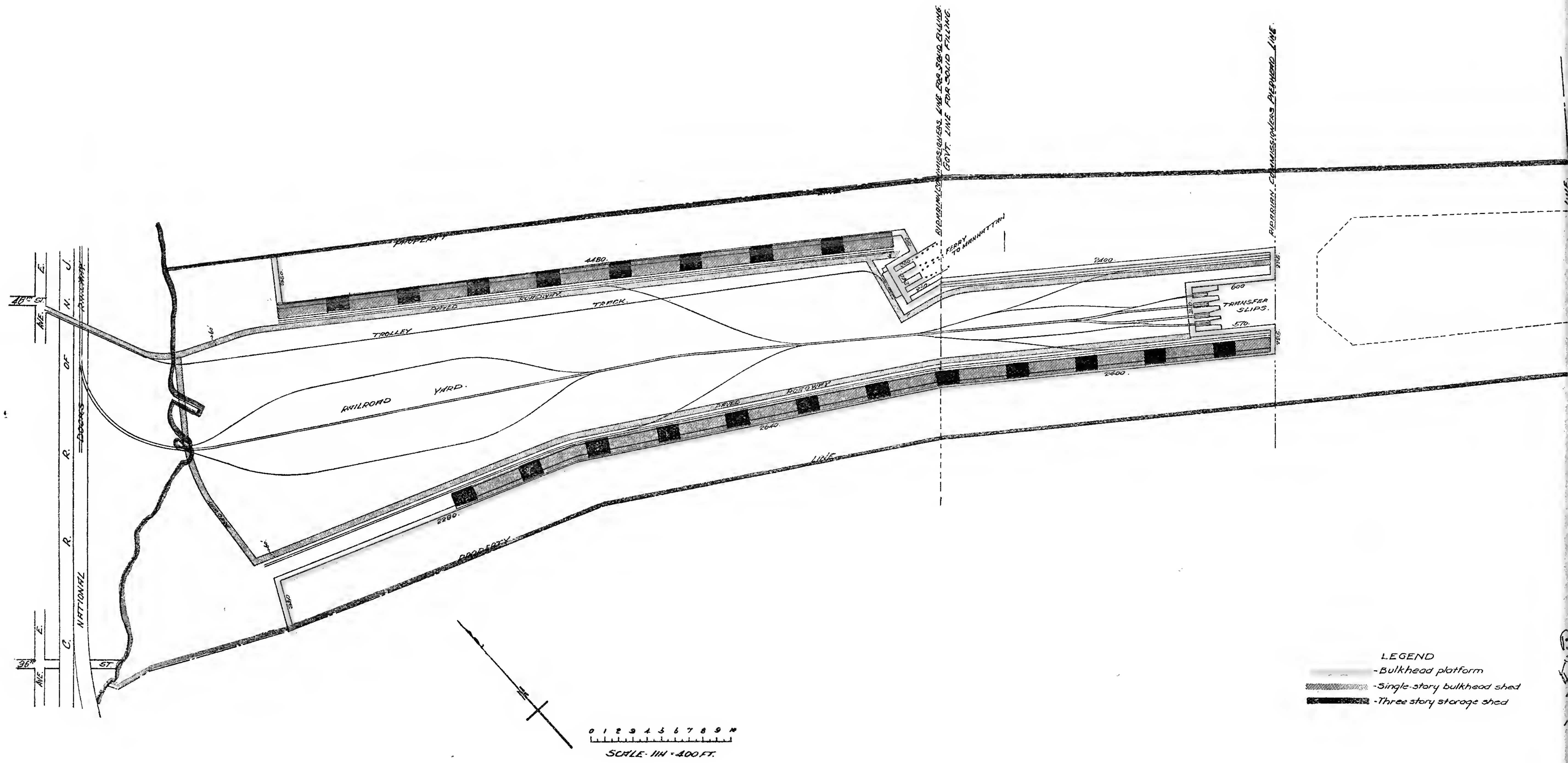
The amount of filling required to reclaim the main peninsula to a plane 10 feet above mean low water is 4,245,238 cu. yds. leavinga deficit of 335,790 cu. yds. which may be easily gotten from the dredging of the channels between the pierhead line adopted by the Federal Government and the present channel to the east.

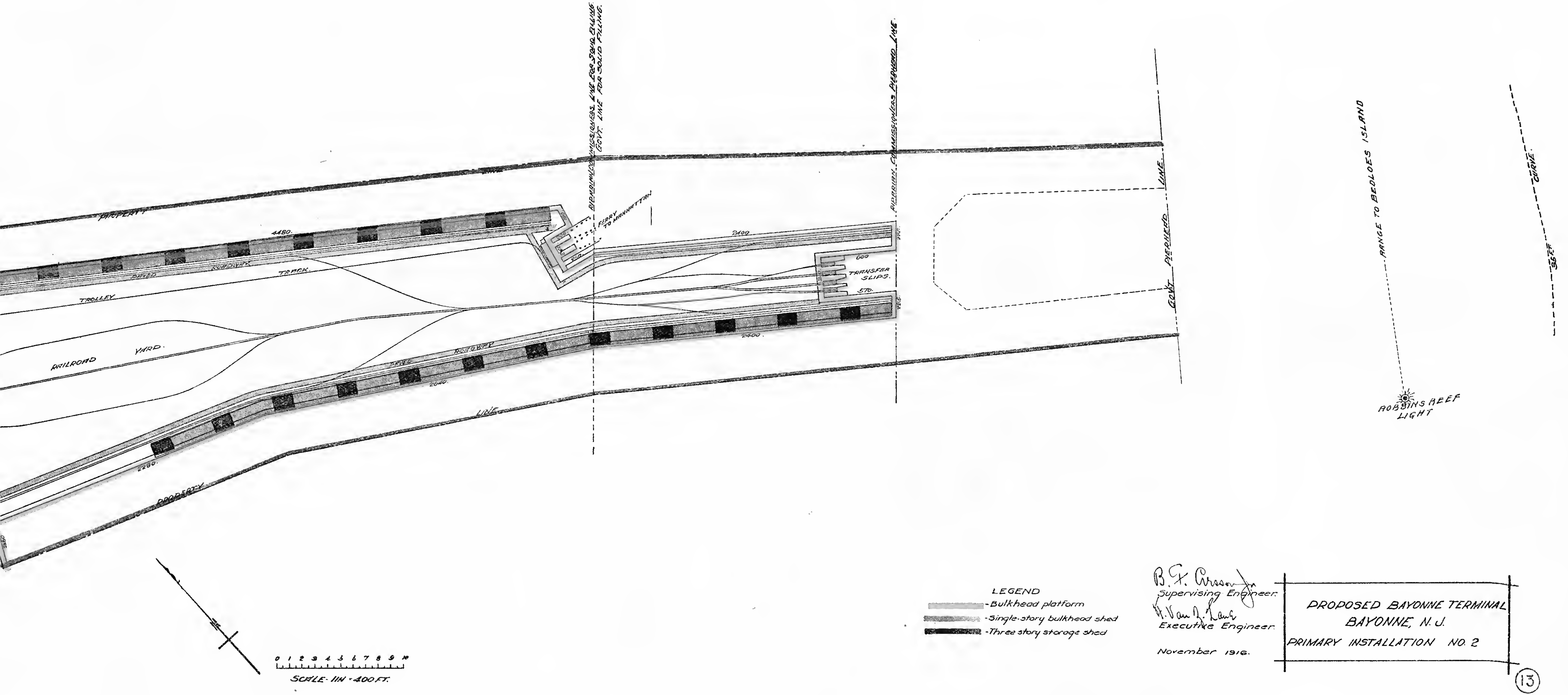
11,780 lineal feet of timber bulkhead with riprap and creosoted timber at 37.50 per lineal foot. 11,780 feet @ $37.50	$ 441.750.00
2,500 feet of bulkhead platform on creosoted piles with a concrete slab deck. 2,500 feet @ $50.00	125,000.00
Bitts and cleats, with mooring devices	1,750.00

Single story bulkhead sheds 2,000 feet long with foundations	233,600.00
Second and third story storage sheds on top of single story shed with foundations	112,500.00
Ferry structures including ferry racks, ferry bridges, pontoons, waiting room, boiler house, boilers, coal pocket, etc.	92,000.00
Three transfer slips and bridges, @ $80,000	240,000.00
Local freight house	48,000.00
Paving—26,000 sq. yds. @ $2.50	65,000.00
Cargo hoists—2,000 ft. @ $6.00	12,000.00
Sprinklers—311,000 sq. ft. @ 14¢	43,540.00
Railroad tracks, classification platforms, sheds, etc.	199,275.17
Trolley tracks, and trolleys—1,800 ft. @ $7	12,600.00
Total	$2,716,751.09
Contingencies, engineering, etc., add 10%	271,675.11
	$2,988,426.20
Interest on half of the investment for 18 months during construction at 4½ per cent	100,859.38
Grand Total for Primary Installation No. 1	$3,089,285.58

Note: If the government recedes the Federal Pierhead Line to agree with the Pierhead Line adopted by the State of New Jersey, then the amount of dredging would be decreased as follows:

Mud—486,720 cu. yds. @ 10¢	$ 48,672.00
Sand—864,320 cu. yds. @ 13¢	112,361.60
	$161,033.60


40th ST.
AVE. E
C. R. R. OF N. J.
NATIONAL DOCKS RAILWAY
36th ST.
AVE. E
PROPERTY
LINE
PROPERTY
4480
2280
2640
2400
2400
600
570
TROLLEY TRACK
PAVED ROADWAY
PAVED ROADWAY
RAILROAD YARD
FERRY TO MANHATTAN
TRANSFER SLIPS.
RIPARIAN COMMISSIONERS LINE FOR SOLID FILLING
GOVT. LINE FOR SOLID FILLING
RIPARIAN COMMISSIONERS PIERHEAD LINE
N
0 1 2 3 4 5 6 7 8 9 10
SCALE · 1 IN = 400 FT.
LEGEND
Bulkhead platform
Single-story bulkhead shed
Three story storage shed



LEGEND

- ▒ -Bulkhead platform
- ▨ -Single-story bulkhead shed
- ■ -Three story storage shed

B. F. Cresson Jr.
Supervising Engineer.
H. Van Z. Lane
Executive Engineer.

November 1916.

PROPOSED BAYONNE TERMINAL
BAYONNE, N.J.
PRIMARY INSTALLATION NO. 2

⑬

PRIMARY INSTALLATION No. 2.

DESCRIPTION.

Channel 35 feet deep, 250 feet bottom width, on the north side of the peninsula dredged from the pierhead line adopted by the Federal Government to the westerly end of the northerly slip.

Channel 35 feet deep, 250 feet bottom width, on the south side of the peninsula dredged from the pierhead line adopted by the Federal Government to the westerly end of the southerly slip.

11,790 lineal feet of timber bulkhead with riprap built around the peninsula to retain the dredged material 40 feet inshore of the line of the finished bulkhead platform, the outshore end being just to the west of the pierhead line established by the State of New Jersey.

17,780 lineal feet of bulkhead platform surrounding the entire peninsula.

10,350 lineal feet one-story bulkhead shed 100 feet wide, giving an area of 1,035,000 sq. ft.

3,000 feet of second and third floor storage sheds built on top of the bulkhead shed providing 555,000 sq. ft. or 7,770,000 cu. ft. storage capacity.

A temporary ferry terminal on the bulkhead line of the northerly slip.

Four transfer slips and bridges at the extreme easterly end of the peninsula.

A railroad yard to support the transfer bridges having a capacity of 190 cars.

A railroad yard with facilities for classifying and assemblying freight with a capacity of 1,980 cars.

Railroad tracks leading to the bulkhead sheds and storage buildings.

Cargo handling appliances.

Freight house for local freight.

Trolley tracks to accommodate passengers between Bayonne and the ferry terminal.

In general this primary installation No. 2 contemplates the reclamation of the main peninsula extending out to the pierhead line established by the State, the dredging of channels inshore of the pierhead line established by the Federal Govrnment to make available all the facilities provided, the constructon of a bulkhead platform with bulkhead sheds and storage sheds around practically the entire peninsula, except for a short length at the northerly side of the peninsula immediately inshore of the pierhead line adopted by the State and at the westerly end of the southerly slip where grain elevators are contemplated where the bulkhead shed has been omitted. These facilities will provide deckage for about 25 modern freight ships in addition to lighters, barges, etc.

It provides a ferry terminal and transfer bridges for railroad cars. The reclamation will amount to 258.3 acres.

The railroad yard will be sufficient to handle a large volume of freight from other parts of the harbor. This will be to the great advantage of this locality as by reason of the large amount of freight received and delivered, much quicker rail shipments between this terminal and the hinterland will be possible than in any other terminal in the harbor.

ESTIMATE FOR PRIMARY INSTALLATION NO. 2.

Mud dredging in the north and south channels west of the Pierhead Line adopted by the Federal Government loaded into scows and disposed of at sea, 2,632,360 cu. yds. @ 10¢	$ 263,236.00
Sand dredging in the north and south channels west of the Pierhead Line established by the Federal Government pumped behind the bulkhead. 2,832,315 cu. yds. @ 13¢	368,200.95
Hard pan dredged in the north and south channels to the west of the Pierhead Line established by the Federal Government pumped behind the bulkhead. 1,634,102 cu. yds. @ 35¢	571,935.70
Note: Hard pan consists of sand, clay and boulders and is referred to in the records of the Passaic Valley Sewerage Commissioners as "cemented triassic formation."	
Total dredging 7,098,777 cu. yds. costing	1,203,372.65
4,466,417 cu. yds. is available for filling.	

The amount of fill required to reclaim the main peninsula to a plane 10 feet above mean low water is 5,123,630, leaving a deficit of 657,213 cu. yds. which may be obtained from the dredging of the channels between the pierhead line adopted by the Federal Government and the present channels to the east.

17,790 lineal feet of timber bulkhead with riprap and creosoted timber at $37.50 per lineal foot. 17,790 lineal feet @ $37.50	$ 667,125.00
17,780 lineal feet of bulkhead platform on creosoted piles with concrete slab deck, 17,780 lineal feet @ $50.00	889,000.00
Bitts, cleats, and mooring devices	10,670.00
Single story bulkhead shed 10,350 feet long with foundations	1,211,400.00
Second and third story storage sheds on top of single story shed with foundations	562,500.00
Ferry structures, including ferry racks, ferry bridges, pontoons, waiting room, boiler house, boilers, coal pocket, etc.	92,000.00
Four transfer slips and bridges @ $80,000	320,000.00
Local freight house	48,000.00
Paving with second-hand paving blocks—112,666 sq. yds. @ $2.50	281,665.00
Cargo hoists	62,100.00
Sprinklers	222,600.00
Railroad tracks, classification platforms, sheds, etc.	362,332.47
Trolley tracks, and trolleys—5,800 ft. @ $7	41,300.00
Total	$5,974,065.12
Contingencies, engineering, etc., add 10%	597,406.51
	$6,571,471,63
Interest on half of the investment for 24 months during construction at 4½ per cent	295,716.22
Grand Total for Primary Installation No. 2	$6,867,187.85

Note: If the Government recedes the Federal Pierhead Line to agree with the Pierhead Line adopted by the State of New Jersey, then the amount of dredging would be decreased as follows:

Mud—486 720 cu. yds. @ 10¢	$ 48.672.00
Sand—864,320 cu. yds. @ 13¢	112.361.60
	$161,033.60

PRIMARY INSTALLATION No. 3.

DESCRIPTION.

Channel 35 feet deep, 250 feet bottom width, on the north side of the peninsula dredged from the pierhead line adopted by the Federal Government to the westerly end of the northerly slip.

Channel 35 feet deep, 250 feet bottom width, on the southerly side of the peninsula dredged from the pierhead line adopted by the Federal Government to the westerly end of the southerly slip.

21,620 lineal feet of timber bulkhead with riprap built around the peninsula to retain the filling 40 feet inshore of the line of the finished bulkhead platform, the outshore end being just to the west of the pierhead line adopted by the Federal Government.

21,620 linal feet of bulkhead platform surrounding the entire peninsula.

14,500 lineal feet of one-story bulkhead shed 100 feet wide giving an area of 1,450,000 sq. ft.

4,350 feet of second and third -story storage sheds built on top of the bulkhead shed providing 804,750 sq. ft, or 11,266,500 cu. ft. of storage capacity.

Temporary ferry terminal near the pierhead line adopted by the State of New Jersey at the northerly slip.

Four transfer slips and bridges at the extreme easterly end of the peninsula.

Railroad yard to support the transfer bridges having a capacity of 190 cars.

A railroad yard with facilities for classifying and assemblying freight with a capacity of 1,980 cars.

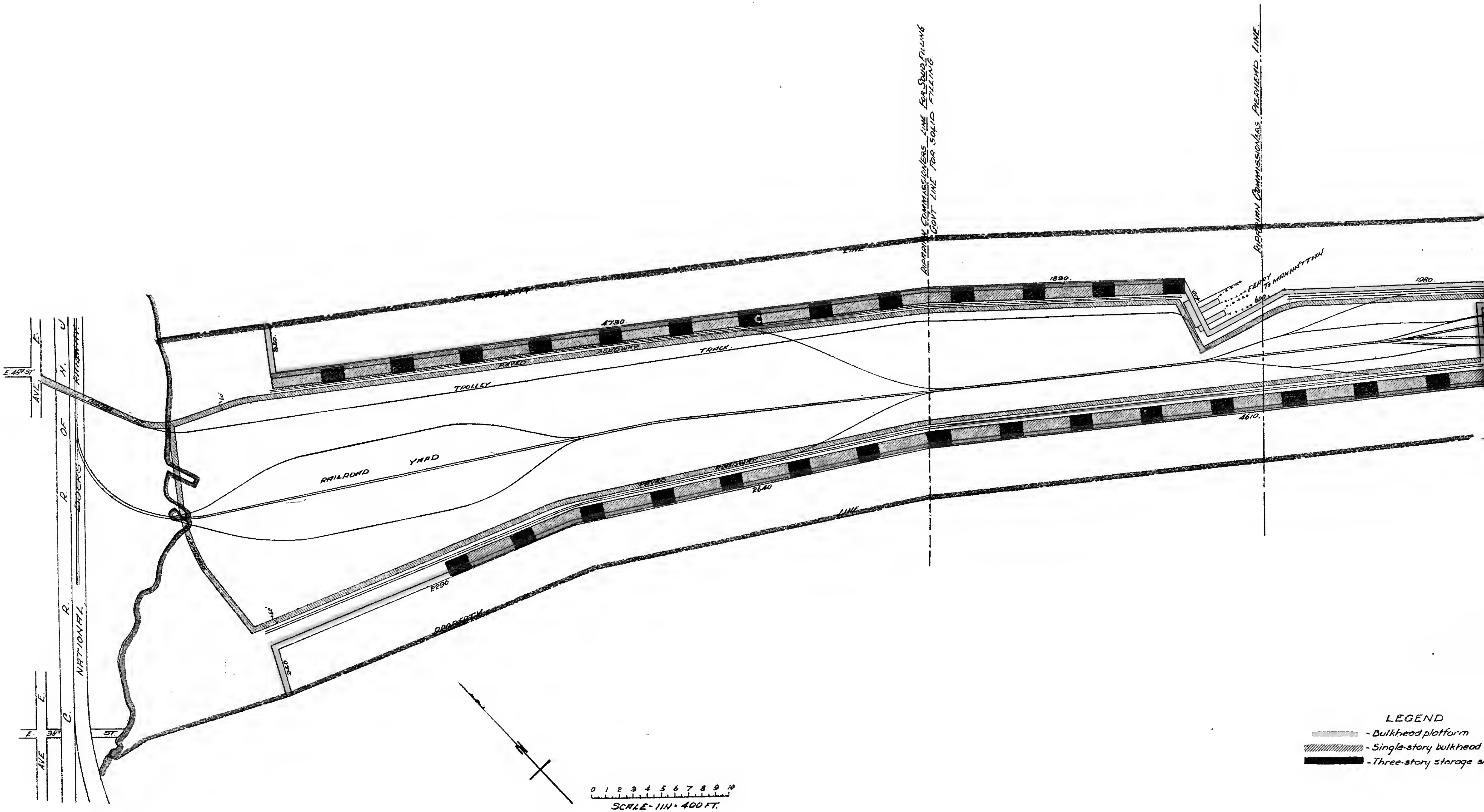
Railroad tracks leading to the bulkhead sheds and storage buildings.

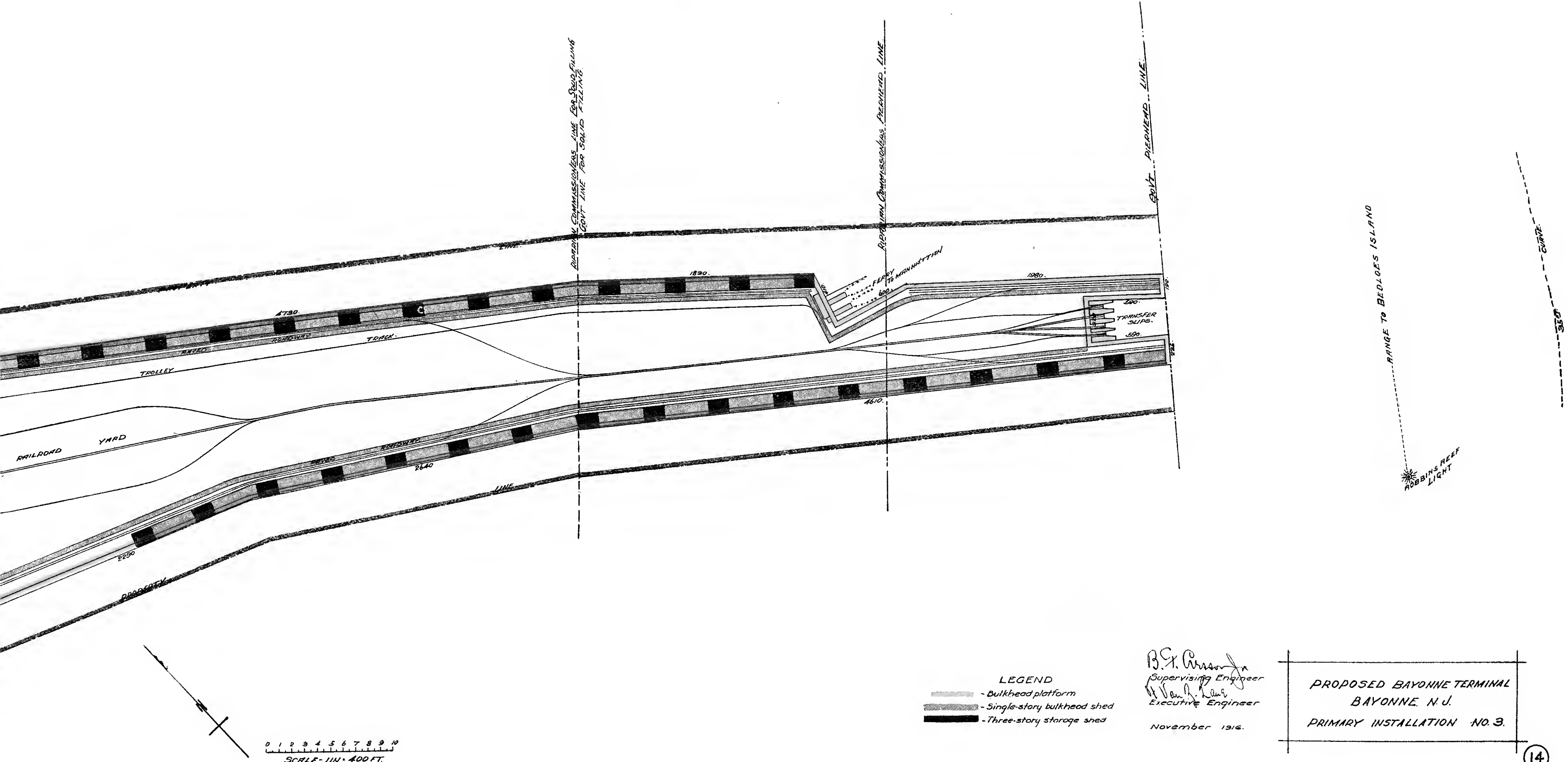
Cargo handling appliances.

Freight house for local freight.

Ferry terminal to accommodate passengers and trucks between the Bayonne Terminal and Manhattan.

In general this Primary Installation No. 3 contemplates the reclamation of the main peninsula extending out to the pierhead line established by the Federal Government, the dredging of channels inshore of pierhead line established by the Federal


RIPARIAN COMMISSIONERS LINE FOR SOLID FILLING
GOV'T LINE FOR SOLID FILLING
RIPARIAN COMMISSIONERS PIERHEAD LINE
PROPERTY LINE
FERRY TO MANHATTAN
1890.
1980.
4730.
4610.
2640
2290
PAVED ROADWAY
TRACK
TROLLEY
RAILROAD YARD
PAVED ROADWAY
PROPERTY LINE
360.
260.
E. 45TH ST.
E. 38TH ST.
AVE. E.
C. R. R. OF N. J.
NATIONAL DOCKS RAILWAY
N
0 1 2 3 4 5 6 7 8 9 10
SCALE - 1 IN. = 400 FT.
LEGEND
- Bulkhead platform
- Single-story bulkhead
- Three-story storage s



LEGEND

░ - Bulkhead platform
▨ - Single-story bulkhead shed
■ - Three-story storage shed

B. F. Cresson Jr
Supervising Engineer
H. Van B. Lane
Executive Engineer

November 1916.

PROPOSED BAYONNE TERMINAL
BAYONNE N. J.
PRIMARY INSTALLATION NO. 3.

⑭

Government making all the facilities provided; the construction of a bulkhead platform with bulkhead sheds and storage sheps around practically the entire peninsula, except for a short length at the northerly side of the peninsula immediate inshore of the pierhead line adopted by the state and at the westerly end of the southerly slip where grain elevators are contemplated where the bulkhead shed has been omitted.

These facilities will provide dockage for about 30 modern freight ships, in addition to lighters, barges, etc.

It provides a ferry terminal and transfer bridges for railroad cars. The reclamation will amount to 287.1 acres.

The railroad yard will be sufficient to handle a large volume of freight from other parts of the harbor. This will be to the great advantage of this locality as by reason of the large amount of freight received and delivered, much quicker rail shipments between this terminal and the hinterland will be possible than in any other terminal in the harbor.

ESTIMATES FOR PRIMARY INSTALLATION NO. 3.

Mud dredging in the north and south channels west of the Pierhead Line adopted by the Federal Government loaded into scows and disposed of at sea. 2,412,189 cu. yds. @ 10¢	$ 241,218.90
Sand dredging in the north and south channels west of the Pierhead Line adopted by the Federal Government pumped behind the bulkhead. 2,682,918 cu. yds. @ 13¢	348,779.21
Hard pan dredged in the north and south channels to the west of the Pierhead Line established by the Federal Government pumped behind the bulkhead. 1,593,159 cu. yds @ 35¢	557,605.65

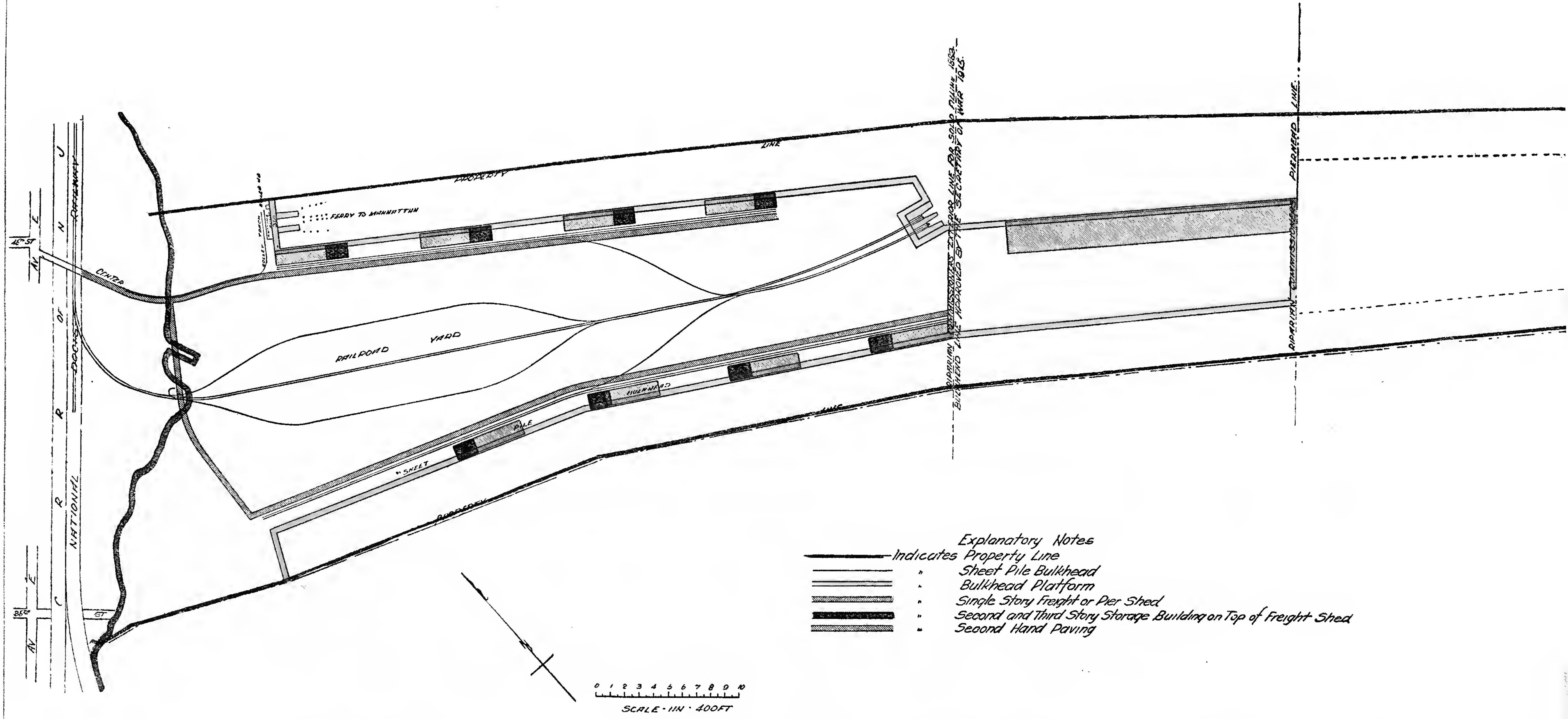
Note: Hard pan consists of sand, clay and boulders and is referred to in the records of the Passaic Valley Sewerage Commissioners as "cemented triassic formation."

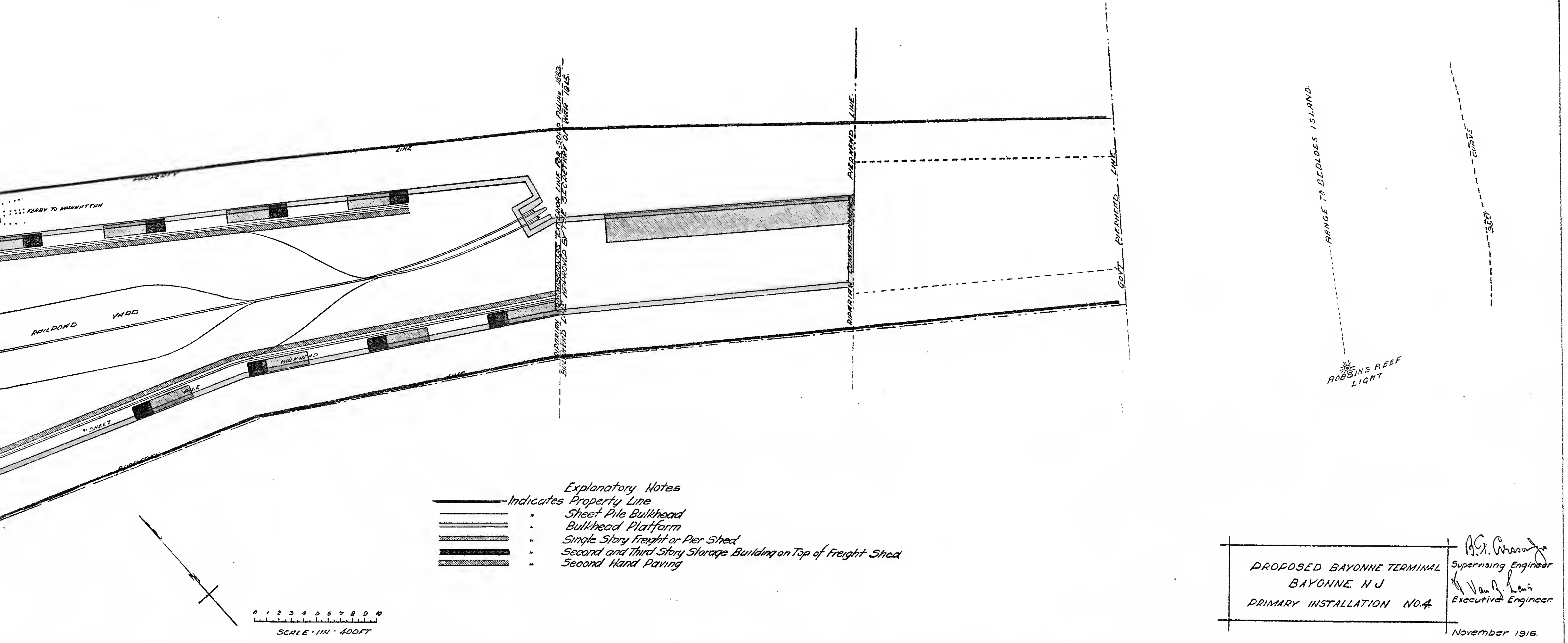
Total dredging 6,688,265 cu. yds. costing	1,147,603.76

4,276,076 cu. yds. are available for filling.

The amount of fill required to reclaim this main peninsula to a plane 10 feet above mean low water is 6,006,504 cu. yds., leaving a deficit of 1,730,428 cu. yds. which may be obtained from dredging outshore of the pierhead line adopted by the Federal Government between that line and the present channels.

21,760 lineal feet of timber with riprap and crecsoted timber at $37.50 per lineal foot. 21,760 lineal feet @ $37.50	$ 816,000.00
21,705 lineal feet of bulkhead platform on creosoted piles with concrete deck slab. 21,705 lineal feet @ $50.00	1,085,250.00
Bitts, cleats and mooring devices	14,430.00
14,500 lineal feet single story bulkhead shed with foundations	1,693,600.00
Second and third story storage sheds on top of single story shed with foundations	815,625.00
Ferry structures, including ferry racks, ferry bridges, pontoons, waiting room, boiler house, boilers, coal pocket, etc.	92,000.00
Four transfer slips with bridges @ $80,000	320,000.00
Local freight house	48,000.00
Paving—141,333 cu. yds. @ $2.50	353,332.50
Cargo hoists	87,000.00
Sprinklers	315,665.00
Railroad tracks, classification platforms, sheds, etc.	392,722.95
Trolley tracks and trolleys—8,000 ft. @ $7	56,000.00
Total	$7,237,229.21
Contingencies, engineering, etc., add 10%	723,722.92
	$7,960,952.13
Interest on half of the investment for 24 months during construction at 4½ per cent	358,242.84
Grand Total for Primary Installation No. 3	$8,319,194.97


45th ST
AV E N U E J
PARKWAY
CENTER
DOCKS
OF
R
R
NATIONAL
35th ST
AV E C
FERRY TO MANHATTAN
PROPERTY LINE
RAILROAD YARD
SHEET PILE BULKHEAD
PROPERTY LINE
RIPARIAN COMMISSIONERS EXTERIOR LINE FOR SOLID FILLING 1883.
BULKHEAD LINE APPROVED BY THE SECRETARY OF WAR 1915.
PIERHEAD LINE
RIPARIAN COMMISSIONERS
N
0 1 2 3 4 5 6 7 8 9 10
SCALE - 1IN - 400FT
Explanatory Notes
Indicates Property Line
" Sheet Pile Bulkhead
" Bulkhead Platform
" Single Story Freight or Pier Shed
" Second and Third Story Storage Building on Top of Freight Shed
" Second Hand Paving



PROPOSED BAYONNE TERMINAL
BAYONNE N J
PRIMARY INSTALLATION NO.4

B. F. Cresson Jr
Supervising Engineer
J. Van B. Lans
Executive Engineer

November 1916.

PRIMARY INSTALLATION No. 4.

DESCRIPTION.

Channel 35 feet deep, 250 feet bottom width, on the north side of the peninsula, excepting that for the outshore 2,400 feet long on the northerly side of the pier. The dredging will create a slip of 600 feet wide at the easterly end and 700 feet wide at the westerly end.

Channel 35 feet deep, 250 feet bottom width, on the south side of the peninsula dredged from the pierhead line adopted by the Federal Government to the westerly end of the southerly slip.

17,160 lineal feet of timber bulkhead with riprap built around the peninsula to retain the filling, 40 feet inshore of the line of the finished bulkhead platform, the outshore end being just west of the pierhead line established by the State of New Jersey.

17,320 lineal feet of timber bulkhead platform surrounding the entire peninsula.

4,000 feet of one-story bulkhead shed 100 feet wide giving an area of 400,000 sq. ft.

1,200 feet of second and third floor storage shed built on top of the bulkhead shed providing 222,000 sq. ft. or 3,108,000 cu. ft. of storage capacity.

2,000 feet of one-story shed 215 feet wide.

Temporary ferry terminal at the westerly end of the northerly slip.

Two transfer slips and bridges on the northerly side just inshore of the riparian commissioners bulkhead line.

A railroad yard with facilities for classifying and assemblying freight with a capacity of 1,980 cars.

Railroad tracks to the bulkhead sheds and storage buildings.

Cargo handling appliances.

Freight house for local freight.

Trolley tracks to accommodate passengers between Bayonne and ferry terminal.

In general this primary installation No. 4 contemplates the reclamation of the main peninsula extending out to the pierhead line established by the State, the dredging of channels inshore of the pierhead line established by the Federal Government to make available all the facilities provided, the construction of a bulkhead platform with bulkhead sheds and storage sheds around practically the entire peninsula, excepting that for the outshore 2,400 feet in length of the bulkhead sheds are omitted on the westerly side in order to provide open wharfage, and that a single story shed 2,800 feet long and 215 feet wide will occupy the northerly side of the outshore portion of the peninsula. These facilities will provide dockage for about 25 modern freight ships in addition to lighters, barges, etc.

It provides a ferry terminal and transfer bridges for railroad cars. The reclamation will amount to 263 7-10 acres.

The railroad yard will be sufficient to handle a large volume of freight from other parts of the harbor. This will be to the great advantage of this locality as by reason of the large amount of freight received and delivered, much quicker rail shipment between this terminal and the hinterland will be possible than in any other terminal in the harbor.

ESTIMATES FOR PRIMARY INSTALLATION NO. 4.

Mud dredging in the north and south channels west of the pierhead line adopted by the Federal Government loaded into scows and disposed of at sea. 2,478,278 cu. yds. @ 10¢	$247,827.80
Sand dredging in the north and south channels west of the pierhead line adopted by the Federal Government pumped behind the bulkhead. 2,498,067 cu. yds. @ 13c.........	324,748.71
Hard pan dredged in the north and south channels to the west of the pierhead line adopted by the Federal Government pumped behind the bulkhead. 1,634,102 cu. yds. @ 35¢	571,935.70
NOTE.—Hard pan consists of sand, clay and boulders, and is referred to in the records of the Passaic Valley Sewerage Commissioners as "cemented triassic formation."	
Total dredging 6,610,447 cu. yds. costing..........	$1,144,512.21

4,132,169 cu. yds. are available for filling.

The amount of fill required to reclaim this peninsula to a plane 10 feet above mean low water is 5,225,949 cu. yds., leaving a deficit of 1,093,380 cu. yds. which may be easily gotten from the dredging of the channels between the pierhead line adopted by the Federal Government and the present channel to the east.

17,160 lineal feet of timber bulkhead with riprap and creosoted timber at $37.50 per lineal foot. 17,160 lineal feet @ $37.50	$643,500.00
17,320 lineal feet of bulkhead platform on creosoted piles with a concrete deck slab. 17,320 lineal feet @ $50.00	866,000.00
Bitts, cleats and mooring devices	11,510.00
Single story bulkhead shed 2,800 feet long with foundations	467,200.00
Second and third story sheds on top of single story sheds with foundations	225,000.00
Pier shed 2,000 feet long 215 feet wide	430,000.00
Ferry structures, including ferry racks, ferry bridges, pontoons, waiting room, boiler house, boilers, coal pocket, etc.	92,000.00
2 transfer slips and bridges @ $80,000	160,000.00
Local freight house	48,000.00
Paving with second hand paving blocks 53,333 sq. yds. @ $2.50	133,332.50
Cargo hoists	36,000.00
Sprinklers	87,080.00
Railroad tracks, classification platforms, sheds, etc.	206,769.86
Trolley tracks and trolleys, 1400 feet @ $7	9,800.00
Total	$4,560,704.57
Contingencies, engineering, etc., add 10%	456,070.45
	$5,016,775.02
Interest on half of the investment for 24 months during struction @ 4½ per cent	225,754.87
Grand total for primary installation No. 4	$5,242,529.89

Note: If the Government recedes the federal pierhead line to agree with the Pierhead Line adopted by the State of New Jersey, then the amount of dredging would be decreased as follows:

Mud—486,720 cu. yds. @ 10¢	$ 48,672.00
Sand—864,320 cu. yds. @ 13¢	112,361.60
	$161,033.60

PRIMARY INSTALLATION No. 5.

DESCRIPTION.

Channel 35 feet deep, 250 feet bottom width, on the northerly side of the peninsula dredged from the pierhead line adopted by the Federal Government to the westerly end of the northerly slip.

Channel 35 feet deep, 250 feet bottom width, on the southern side of the peninsula dredged from the pierhead line adopted by the Federal Government to the westerly end of the southerly slip.

20,160 lineal feet of timber bulkhead with riprap built around the peninsula to retain the filling, 40 feet inshore of the line of finished bulkhead platform, the outshore end being just west of the pierhead line established by the Federal Government.

20,300 lineal feet of timber bulkhead platform surrounding the entire peninsula.

13,500 feet of one-story bulkhead shed 100 feet wide giving an area of 1,350,000 sq. ft.

3,000 feet of second and third floor storage shed built on top of the bulkhead shed providing 555,000 sq. ft. or 7,770,000 cubic feet of storage capacity.

Temporary ferry terminal at the outshore end of the peninsula with a laying up slip.

Two transfer slips and bridges at the outshore end just inshore of the United States Government bulkhead line.

A railroad yard with facilities for classifying and assemblying freight with a capacity of 1,000 cars.

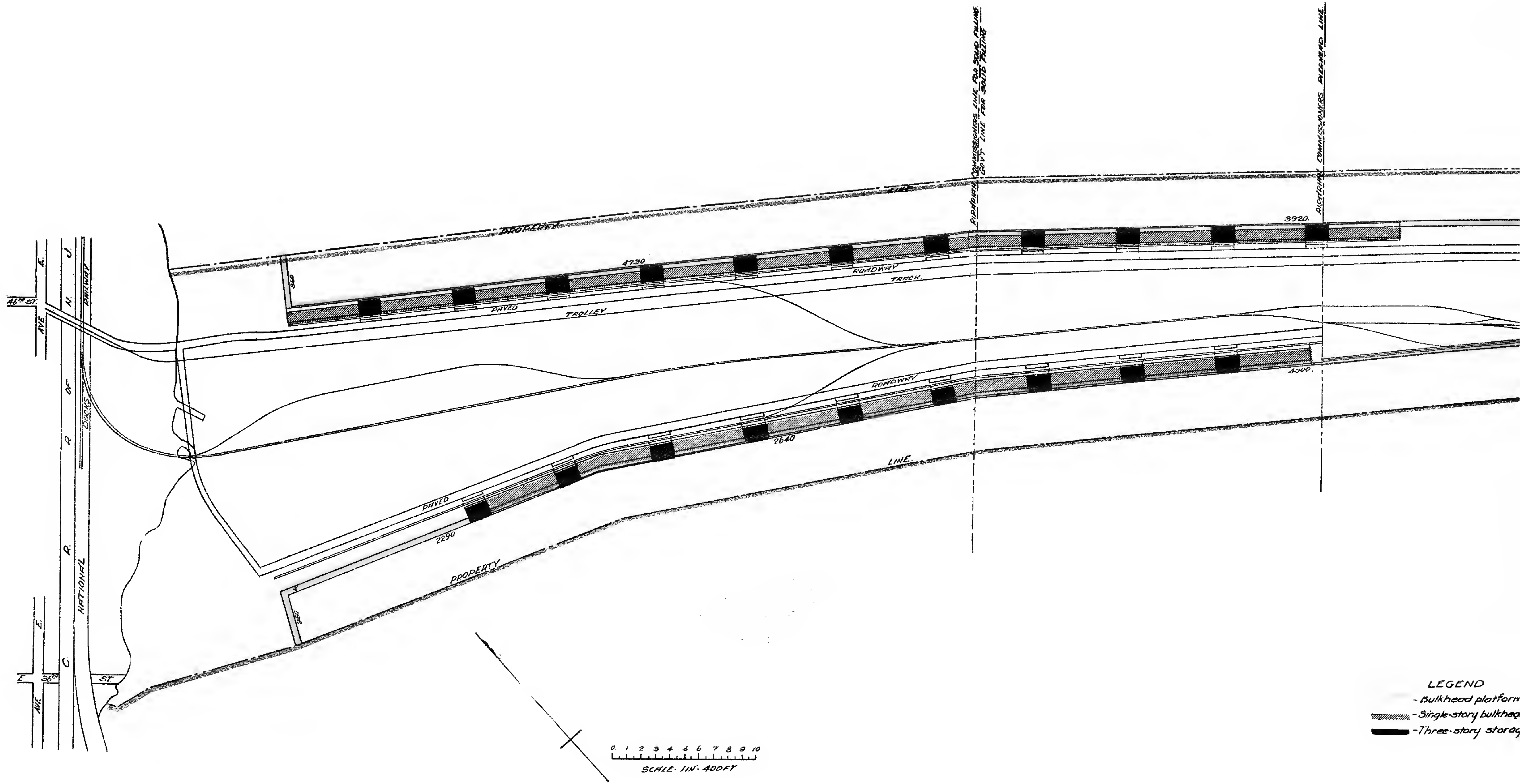
Railroad tracks to the bulkhead sheds and storage buildings.

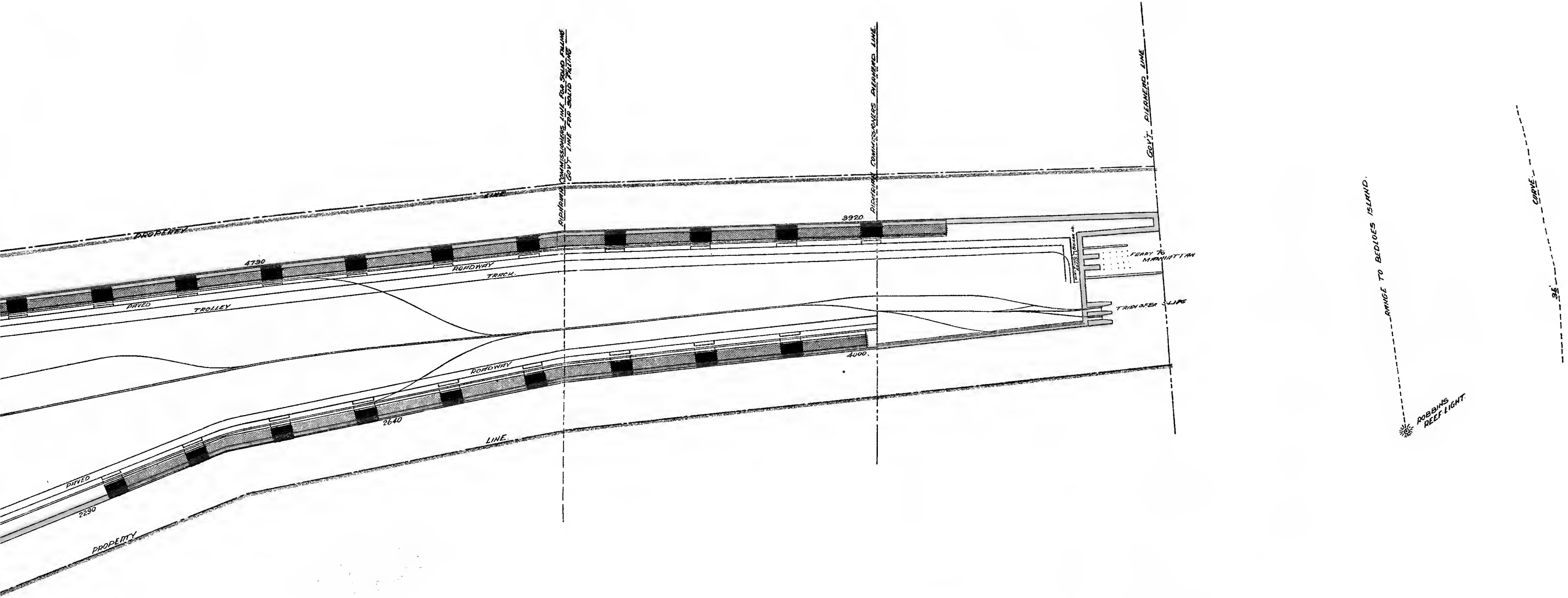
Cargo handling appliances.

Freight house for local freight

Trolley tracks to accommodate passengers between Bayonne and ferry terminal.

In general this primary installation No. 5 contemplates the reclamation of the main peninsula extending out to the pierhead line established by the Government, the dredging of channels inshore of the pierhead line established by the Federal Government to make available all the facilities provided, the construction of a bulkhead platform with bulkhead sheds and storage sheds around practically the entire peninsula, excepting that for


46th ST.
AVE. E.
N. J.
RAILWAY
R. R. OF
NATIONAL
DOCKS
E. C.
AVE. E
36th ST.
PROPERTY
LINE
RIPARIAN COMMISSIONERS LINE FOR SOLID FILLING
GOV'T LINE FOR SOLID FILLING
RIPARIAN COMMISSIONERS PIERHEAD LINE.
350
4730
3920.
PAVED
TROLLEY
ROADWAY
TRACK.
ROADWAY
4000.
2640
PAVED
2290
LINE.
PROPERTY
350
0 1 2 3 4 5 6 7 8 9 10
SCALE 1 IN = 400 FT
LEGEND
- Bulkhead platform
- Single-story bulkhea
- Three-story storag



0 1 2 3 4 5 6 7 8 9 10

SCALE · 1 IN = 400 FT

LEGEND

- ▒ - Bulkhead platform
- ▨ - Single-story bulkhead shed
- ■ - Three-story storage shed

B. F. Cresson Jr
Supervising Engineer

H. Van Z. Lang
Executive Engineer

November 1916.

PROPOSED BAYONNE TERMINAL
BAYONNE, N. J.
PRIMARY INSTALLATION NO. 5.

⑯

the outshore 2,400 feet in length the bulkhead sheds are omitted on the westerly side in order to provide open wharfage. These facilities will provide for about 30 modern freight ships in addition to lighters, barges, etc.

It provides a ferry terminal and transfer bridges for railroad cars. The reclamation will amount to 310 7-10 acres.

The railroad yard will be sufficient to handle a large volume of freight from other parts of the harbor. This will be to the great advantage of this locality as by reason of the large amount of freight received and delivered, much quicker rail shipments between this terminal and the hinterland will be possible than in any other terminal in the harbor.

ESTIMATES FOR PRIMARY INSTALLATION NO. 5.

Mud dredging in the north and south channels west of the pierhead line adopted by the Federal Government loaded into scows and disposed of at sea. 2,310,127 cu. yds. @ 10¢	$231,012.70
Sand dredging in the north and south channels west of the pierhead line adopted by the Federal Government pumped behind the bulkhead. 2,316,289 cu. yds. @ 13¢	301,117.57
Hard pan dredged in the north and south channels to the west of the pierhead line adopted by the Federal Government pumped behind the bulkhead. 1,593,159 cu. yds. @ 35¢	557,605.65
Note: Hard pan consists of sand, clay and boulders and is referred to in the records of the Passaic Valley Sewerage Commissioners as "Cemented triassic formation."	
Total dredging 6,219.575 cu. yds. costing	$1,089,735.92

3,909,448 cu. yds. are available for filling.

The amount of fill required to reclaim this peninsula to a plane 10 feet above mean low water is 6,697,099 cu. yds. leaving a deficit of 2,787,651 cu. yds which may be easily obtained from the dredging of the channels between the pierhead line adopted by the Federal Government and the present channel to the east and from the waste materials about the harbor.

20,160 lineal feet of timber bulkhead with riprap and creosoted timber @ $37.50 per lineal foot. 20,160 lineal feet @ $37.50	$756,000.00
20.300 lineal feet of bulkhead platform on creosoted piles with a concrete deck slab. 20,300 lineal feet @ $50.00	1,015,000.00

Bitts, cleats and mooring devices	13,510.00
Single story bulkhead, 10,500 feet long	1,602,000.00
Second and third story bulkhead sheds on top of single story sheds with foundations	562,500.00
Ferry structures, including ferry racks, ferry bridges, pontoons, waiting room, boiler house, boilers, coal pocket, etc.	92,000.00
Laying-up slip, 600 ft. of rack @ $30.00	18,000.00
2 transfer slips and bridges @ $80,000	160,000.00
Local freight house	48,000.00
Paving with second hand paving blocks 129,000 sq. yds. @ $2.50	322,500.00
Cargo hoists	81,000.00
Sprinklers	266,700.00
Railroad tracks, classification platforms, sheds, etc.	196,000.00
Trolley tracks and trolleys 10,100 feet @ $7	70,700.00
Total	$6,293,645.92
Contingencies, engineering, etc., add 10%	629,364.59
	$6,923,010.51
Interest on half of the investment for 24 months during construction @ 4½ per cent	311,535.47
Grand total for primary installation No. 5	$7,234,545.98

General Conclusions.

The foregoing in our judgment indicates that a properly designed, built and operated terminal at the location in question will bring great benefits to the City of Bayonne, to the territory adjacent to it, to the State of New Jersey, to the Port of New York and to the country at large, which passes such a great volume of commerce through the Port of New York.

The railroads which have terminals in the New Jersey portion of the harbor will be able to handle their freight which passes through this terminal at a much lower cost than at any other terminal at the Port of New York.

Taking all things into consideration we are of the opinion that the terminal will develop best and quickest and bring the earliest benefits to the locality by constructing in the first instance the plan known as primary installation No. 5.

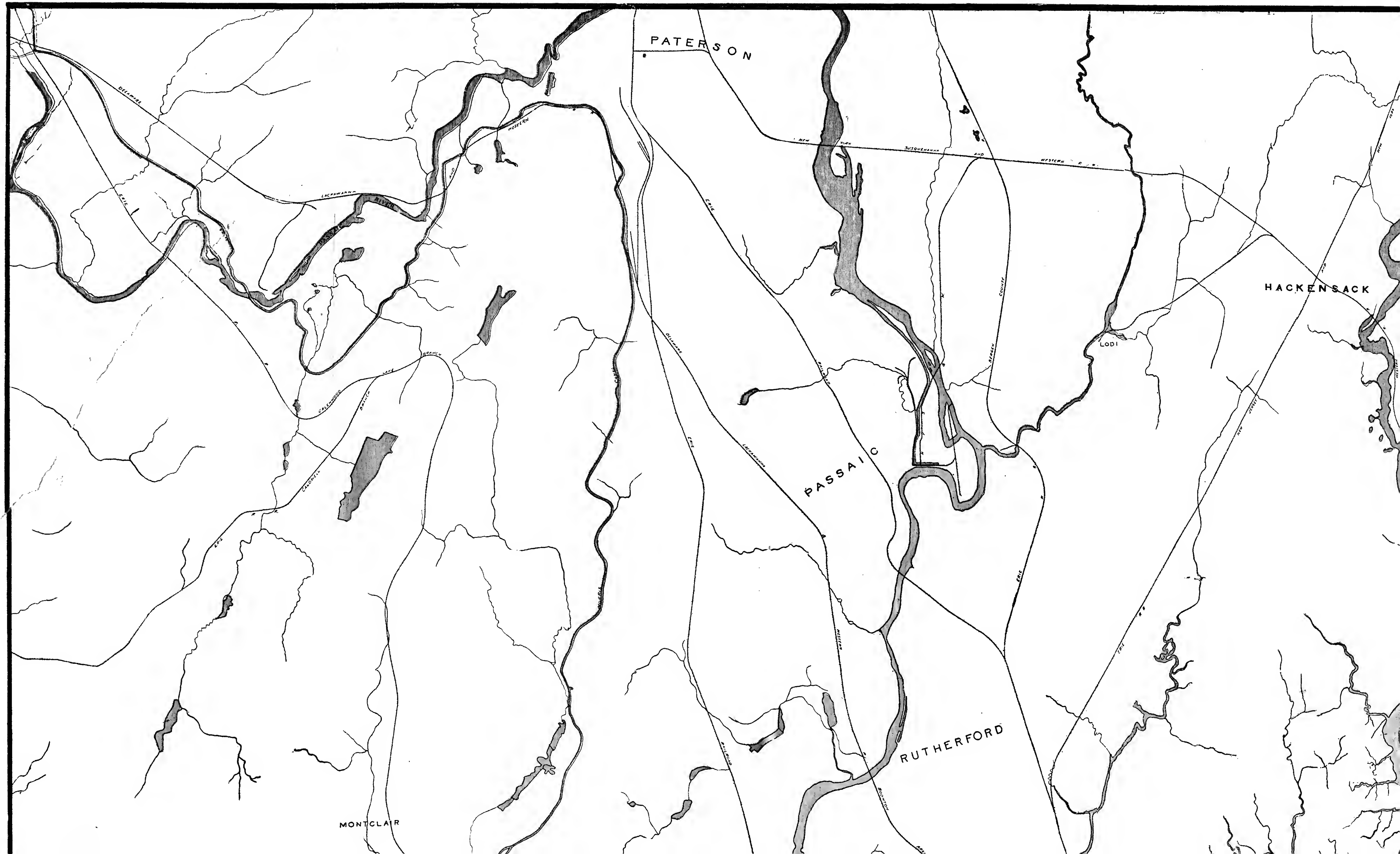
Primary installation No. 5 comprises features which are believed to be superior to those included in the other primary installations, and is rather a conclusion resulting from the development of the first four. It brings the easterly end of the development to the pierhead line established by the Federal Government, and is as close as seems desirable to the present main channel in the Upper Bay.

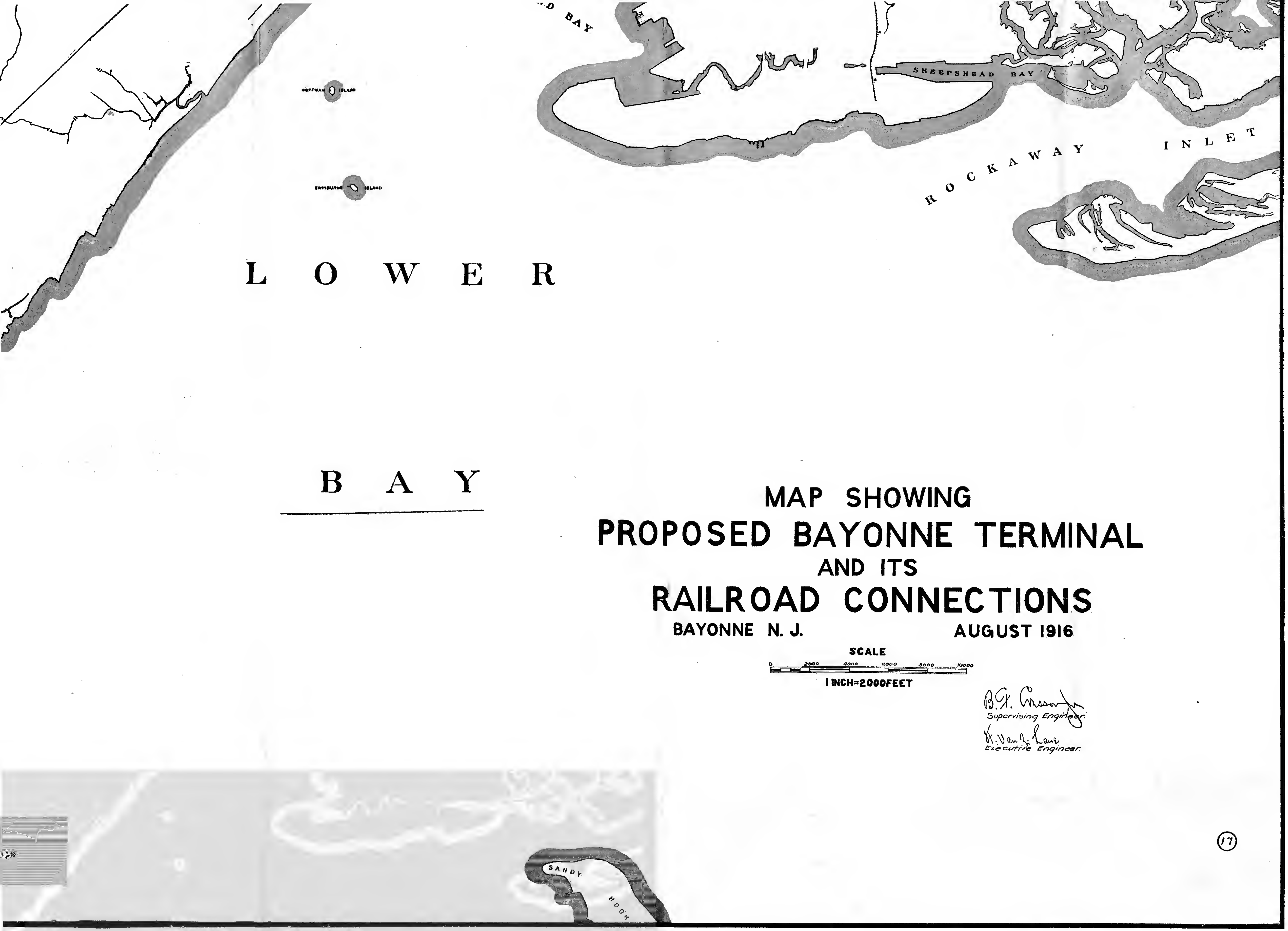
This primary installation will create 20,300 lineal feet of deep water frontage against which vessels can dock, where there now exists less than 2,800 lineal feet of undeveloped frontage which can now be reached with difficulty by boats drawing one foot of water.

The development of the Bayonne Terminal should be under public control preferable in the ownership of the municipality, at least as far as the land is concerned. In this way the character of development can be better controlled and a greater success can result to the entire community. No effort should be made to extort high rentals from the improvements, but it should be insisted that the improvements made by the municipality should be self-sustaining. In view of the demands for facilities about New York there should be no difficulty whatever in arranging a contract under which this should result.

All of which is respectfully submitted.

(Signed) B. F. CRESSON, Jr.,
Supervising Engineer,
(Signed) F VAN Z. LANE,
Executive Engineer.


PATERSON
HACKENSACK
LODI
PASSAIC
RUTHERFORD
MONTCLAIR
DELAWARE LACKAWANNA AND WESTERN
PASSAIC RIVER
ERIE
NEW YORK SUSQUEHANNA AND WESTERN R.R.
BERGEN COUNTY
GREENWOOD LAKE BRANCH
CALDWELL
MORRIS CANAL
DELAWARE LACKAWANNA
ERIE RAILROAD
NEW JERSEY
ERIE R.R.
BOONTON



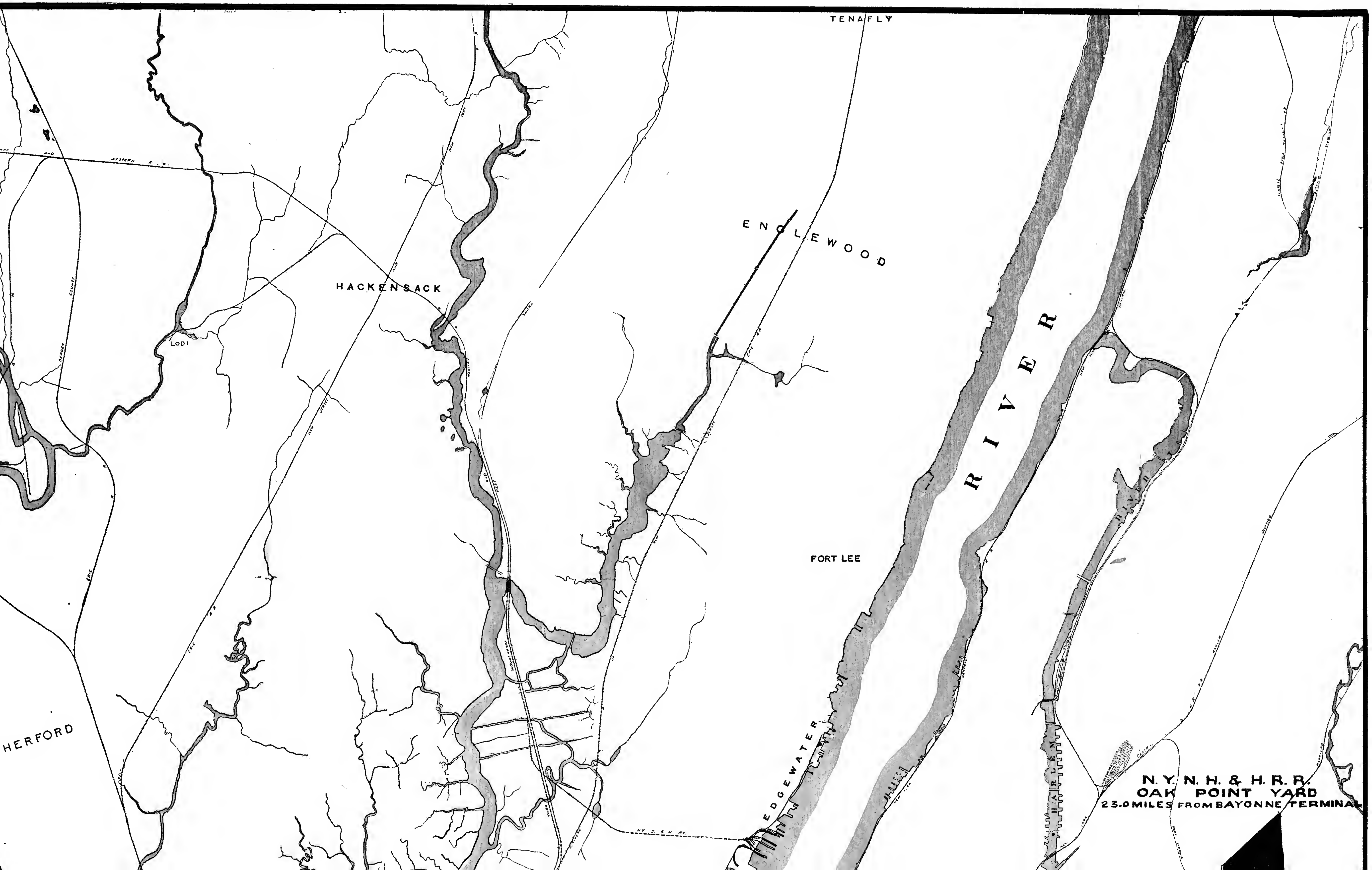
MAP SHOWING
PROPOSED BAYONNE TERMINAL
AND ITS
RAILROAD CONNECTIONS
BAYONNE N. J. AUGUST 1916

SCALE

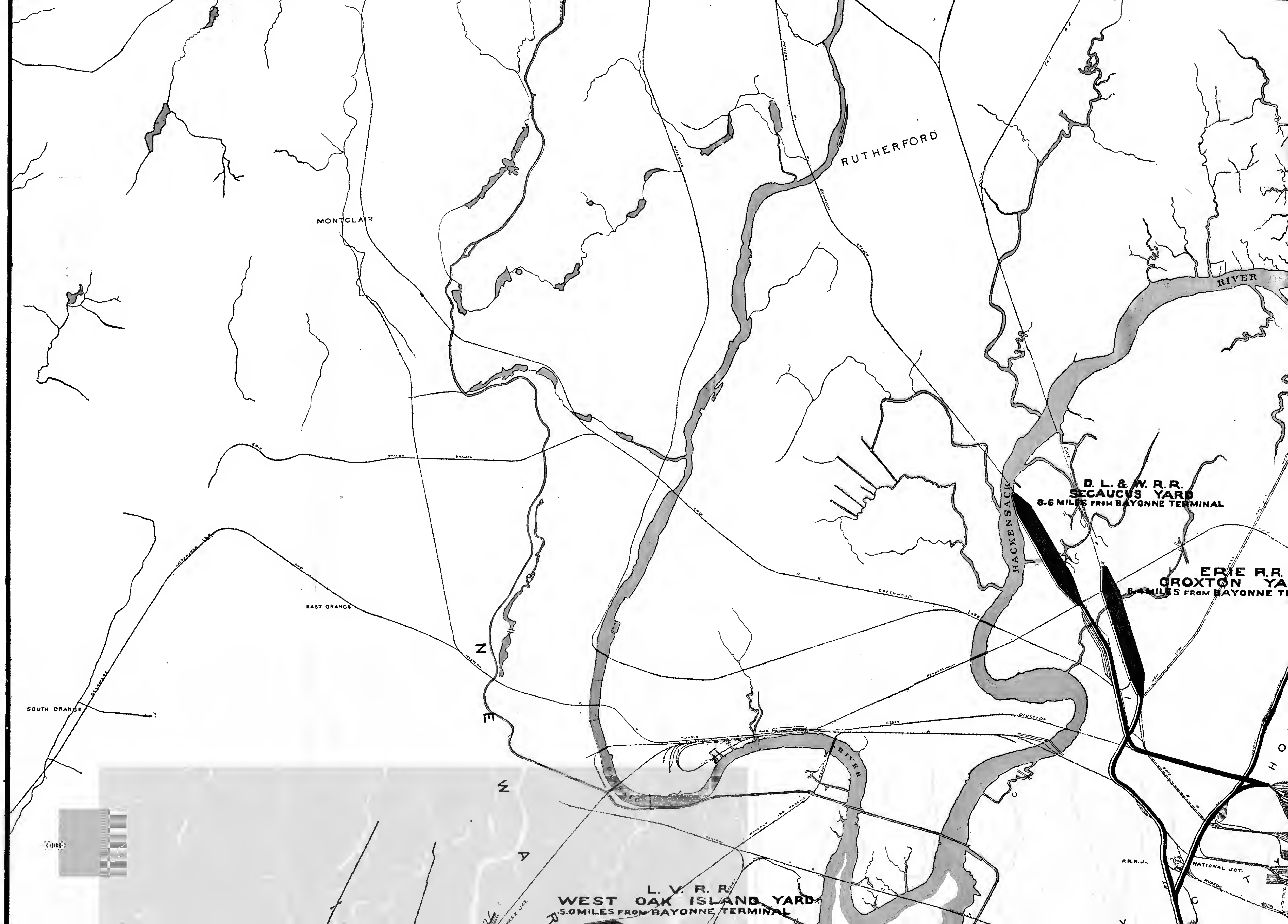
1 INCH=2000FEET

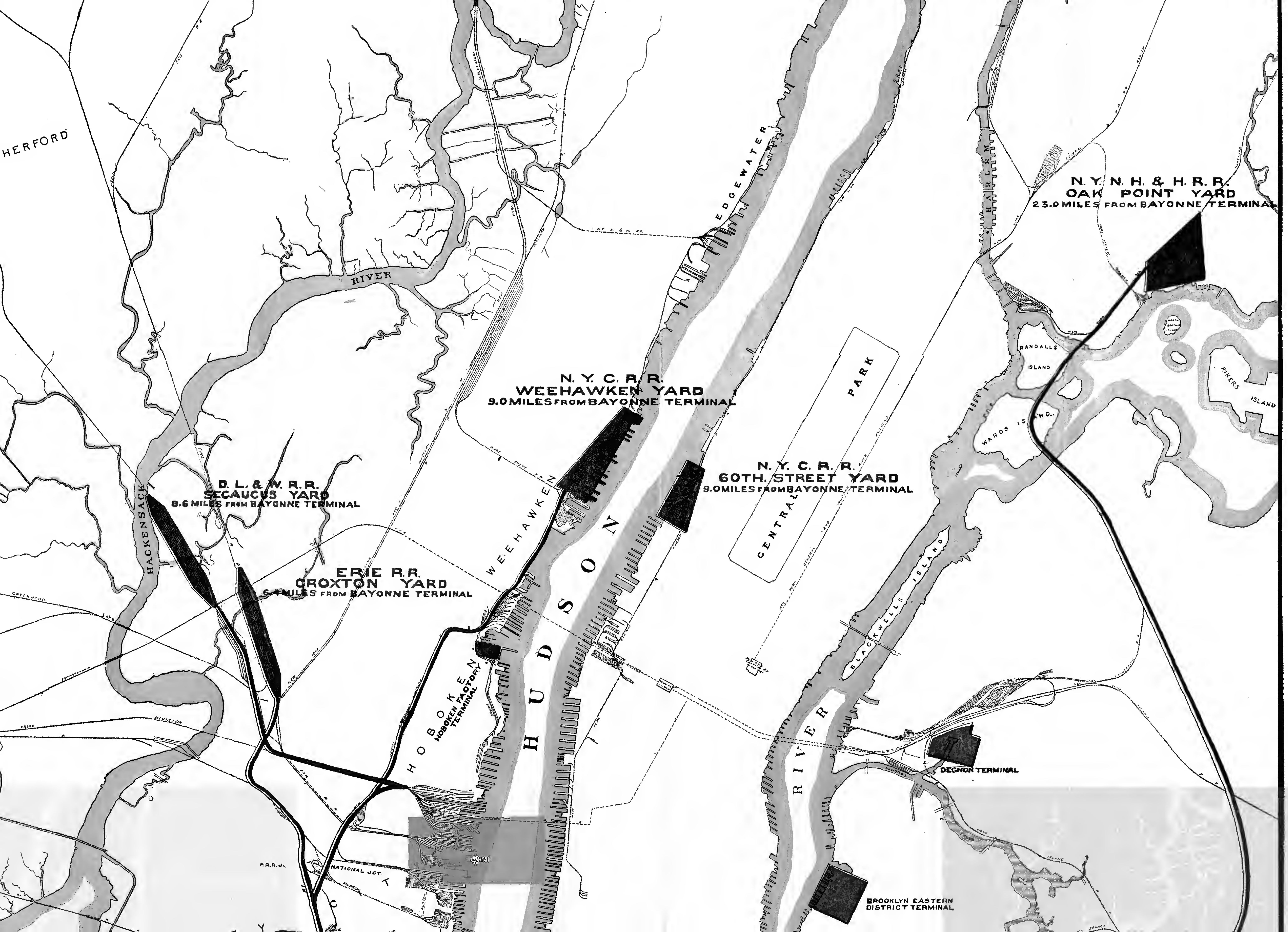
B. F. Cresson Jr.
Supervising Engineer.
K. Van Z. Lane
Executive Engineer.

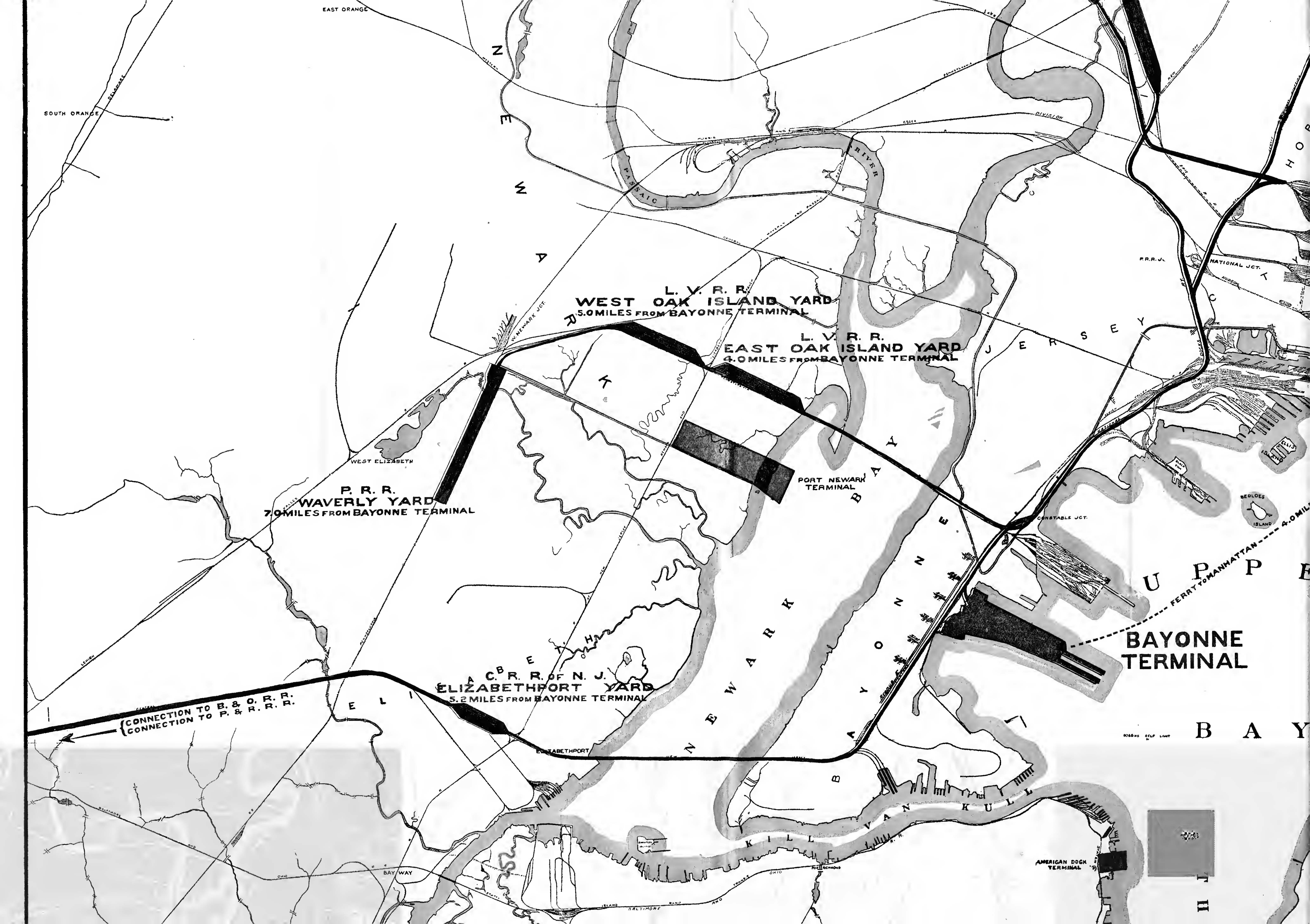
⑰

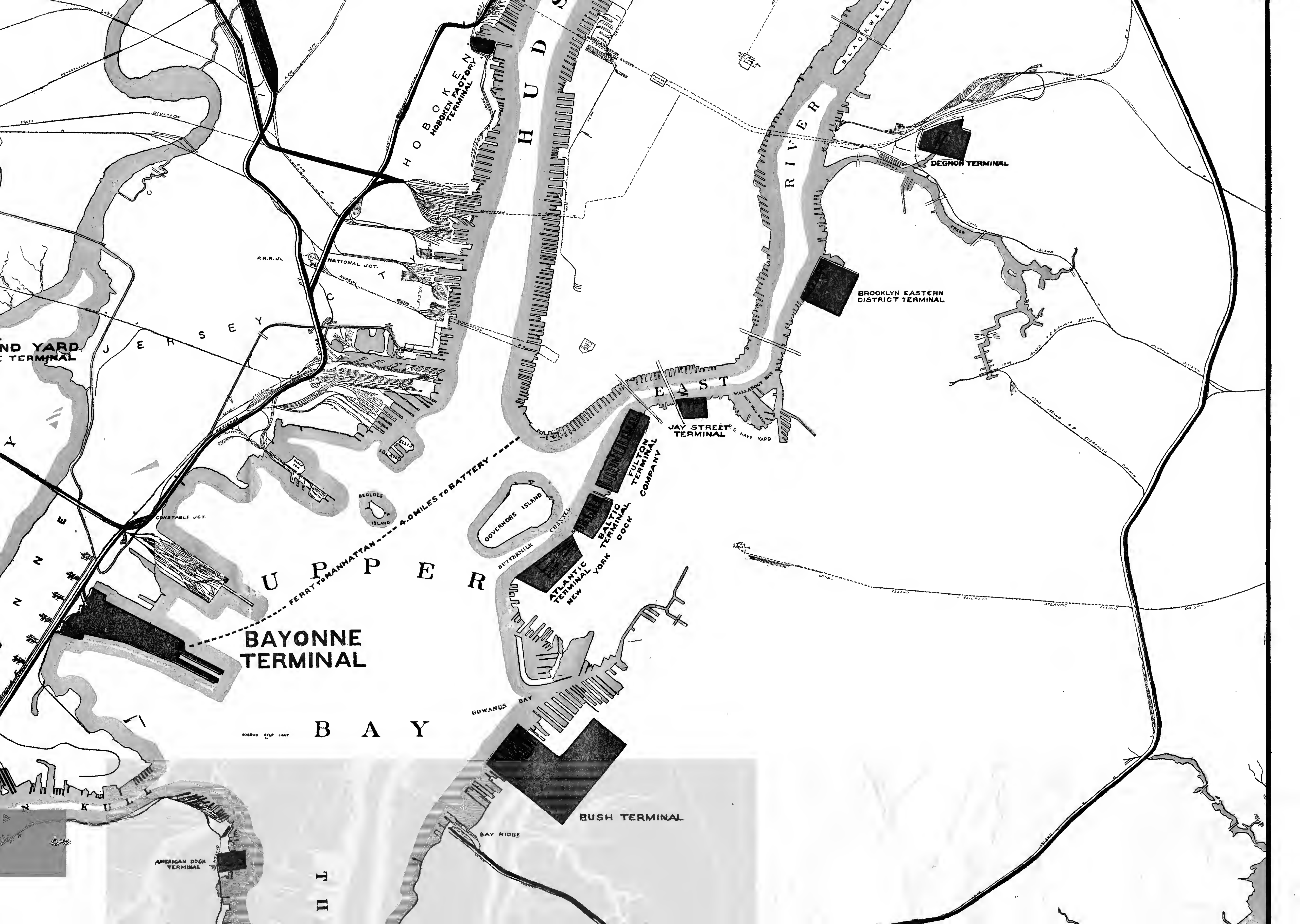


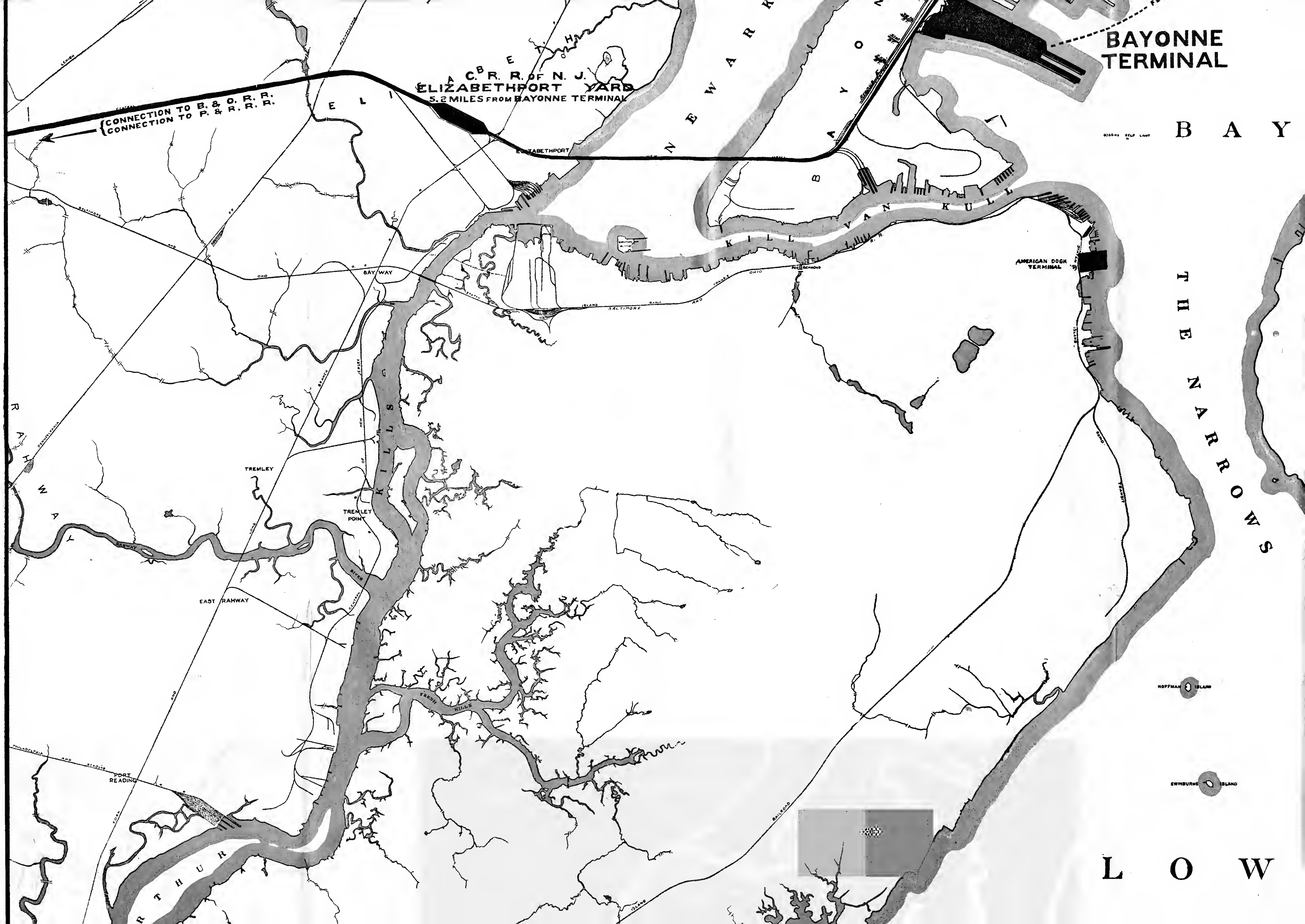
N. Y. N. H. & H. R. R.
OAK POINT YARD
23.0 MILES FROM BAYONNE TERMINAL

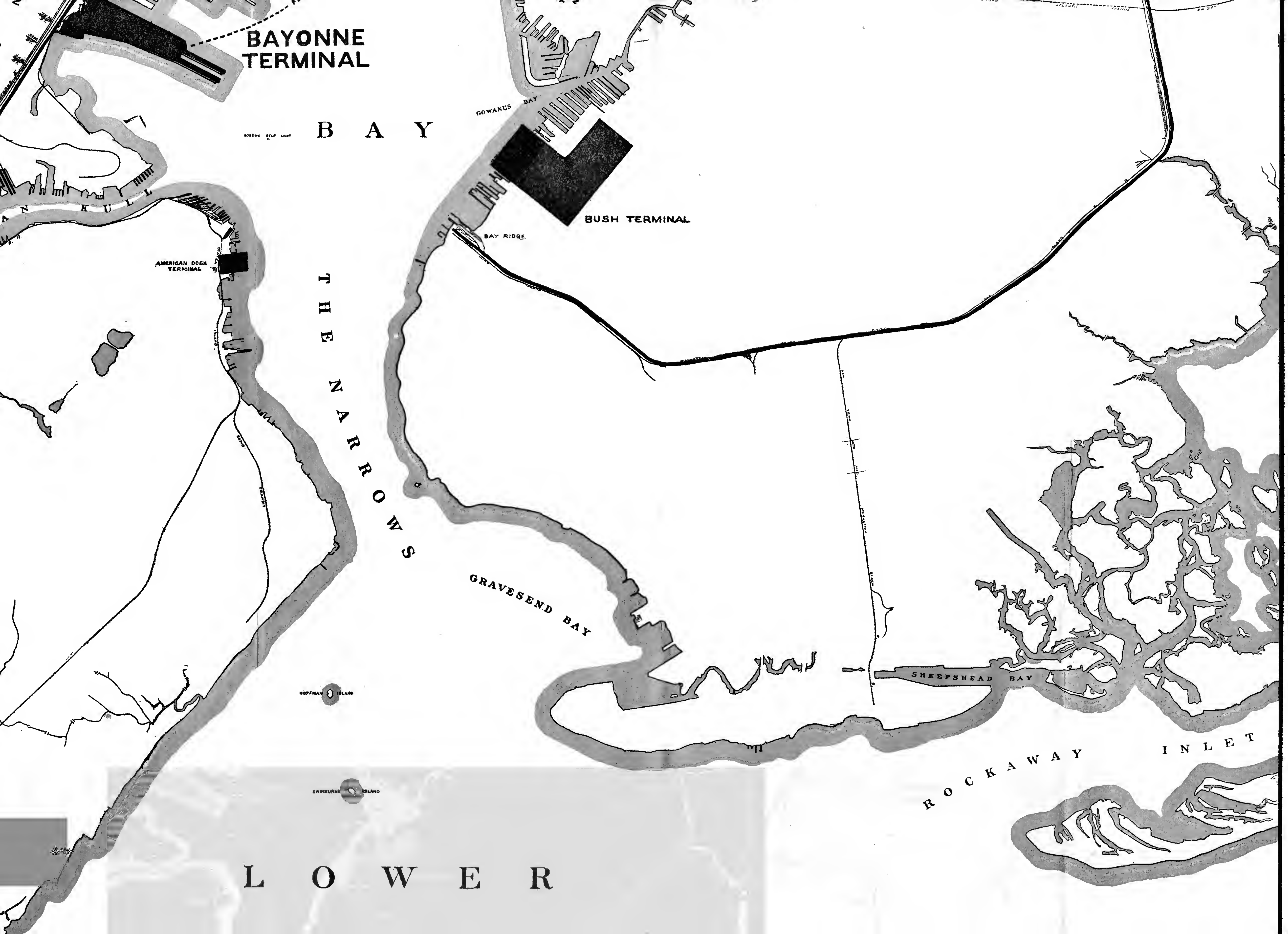

MONTCLAIR
RUTHERFORD
RIVER
HACKENSACK
D. L. & W. R.R.
SECAUCUS YARD
8.6 MILES FROM BAYONNE TERMINAL
ERIE R.R.
CROXTON YA
6.4 MILES FROM BAYONNE T
ERIE
ORANGE
BRANCH
EAST ORANGE
SOUTH ORANGE
DELAWARE LACKAWANNA AND
WESTERN
GREENWOOD
LAKE
PENNSYLVANIA
ESSEX
DIVISION
MORRIS AND
PASSAIC
RIVER
N
E
W
A
R
NATIONAL JCT.
HUDSON
R.R.R. JC.
H
O
C
T
Y
L. V. R. R.
WEST OAK ISLAND YARD
5.0 MILES FROM BAYONNE TERMINAL

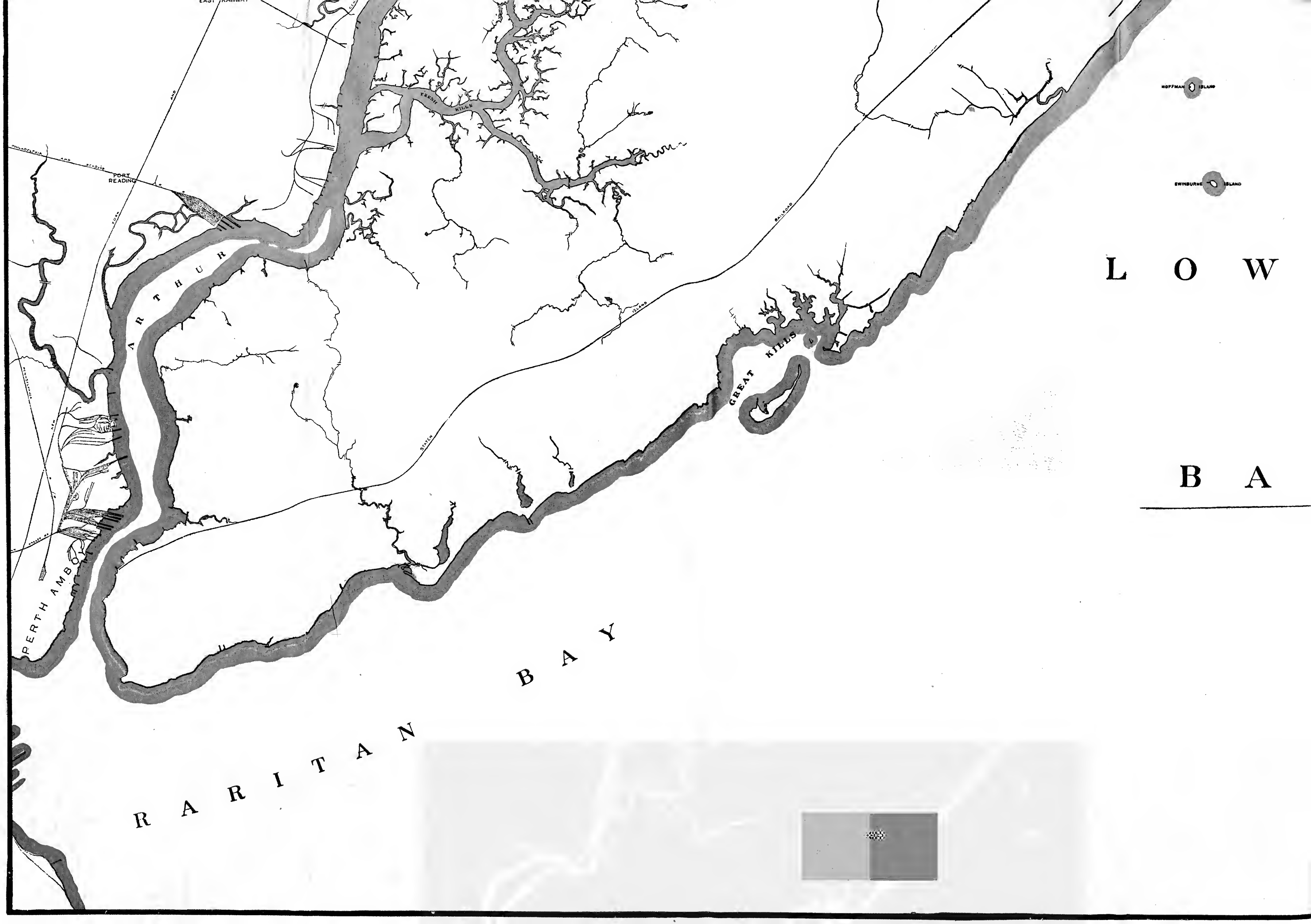

HERFORD
RIVER
HACKENSACK
D.L.&W.R.R.
SECAUCUS YARD
8.6 MILES FROM BAYONNE TERMINAL
ERIE R.R.
CROXTON YARD
6.4 MILES FROM BAYONNE TERMINAL
GREENWOOD
Lake
ESSEX
DIVISION
P.R.R. JC.
NATIONAL JCT.
HUDSON
WEEHAWKEN
HOBOKEN
HOBOKEN FACTORY TERMINAL
N.Y.C.R.R.
WEEHAWKEN YARD
9.0 MILES FROM BAYONNE TERMINAL
EDGEWATER
HUDSON
N.Y.C.R.R.
60TH. STREET YARD
9.0 MILES FROM BAYONNE TERMINAL
CENTRAL PARK
HARLEM
N.Y.N.H.&H.R.R.
OAK POINT YARD
23.0 MILES FROM BAYONNE TERMINAL
RANDALLS ISLAND
WARDS ISLAND
RIKERS ISLAND
BLACKWELLS ISLAND
RIVER
DEGNON TERMINAL
BROOKLYN EASTERN DISTRICT TERMINAL


EAST ORANGE
SOUTH ORANGE
NEWARK
PASSAIC RIVER
DIVISION
L. V. R. R.
WEST OAK ISLAND YARD
5.0 MILES FROM BAYONNE TERMINAL
L. V. R. R.
EAST OAK ISLAND YARD
4.0 MILES FROM BAYONNE TERMINAL
W. NEWARK JCT.
JERSEY CITY
P.R.R. JC.
NATIONAL JCT.
HO
WEST ELIZABETH
P. R. R.
WAVERLY YARD
7.0 MILES FROM BAYONNE TERMINAL
PORT NEWARK TERMINAL
NEWARK BAY
ELLIS ISLAND
BEDLOES ISLAND
CONSTABLE JCT.
FERRY TO MANHATTAN 4.0 MIL
UPPE
BAYONNE TERMINAL
BAY
BAYONNE
C. R. R. OF N. J.
ELIZABETHPORT YARD
5.2 MILES FROM BAYONNE TERMINAL
ELIZABETH
{ CONNECTION TO B. & O. R. R.
CONNECTION TO P. & R. R. R.
ELIZABETHPORT
KILL VAN KULL
BAY WAY
PORT RICHMOND
AMERICAN DOCK TERMINAL


HOBOKEN FACTORY TERMINAL
HOBOKEN
HUDS
JERSEY CITY
P.R.R. JCT.
NATIONAL JCT.
CONSTABLE JCT.
ND YARD
TERMINAL
RIVER
BLACKWELL
EAST
DEGNON TERMINAL
BROOKLYN EASTERN DISTRICT TERMINAL
WALLABOUT BAY
JAY STREET TERMINAL
U.S. NAVY YARD
ELLIS ISLAND
BEDLOES ISLAND
GOVERNORS ISLAND
BUTTERMILK CHANNEL
FULTON TERMINAL
BALTIC TERMINAL
ATLANTIC TERMINAL
NEW YORK DOCK COMPANY
FERRY TO MANHATTAN 4.0 MILES TO BATTERY
UPPER BAY
BAYONNE TERMINAL
GOWANUS BAY
ROBBINS REEF LIGHT
BUSH TERMINAL
BAY RIDGE
KULL
AMERICAN DOCK TERMINAL
TH
LONG ISLAND RAILROAD
ATLANTIC AVENUE DIVISION


BAYONNE TERMINAL
C. R. R. OF N. J.
ELIZABETHPORT YARD
5.2 MILES FROM BAYONNE TERMINAL
CONNECTION TO B. & O. R. R.
CONNECTION TO P. & R. R. R.
ELIZABETH
ELIZABETHPORT
NEWARK
BAYONNE
BAY
KILL VAN KULL
AMERICAN DOCK TERMINAL
PORT RICHMOND
BAY WAY
BALTIMORE AND OHIO
STATEN ISLAND RAPID TRANSIT
THE NARROWS
RAHWAY
RAHWAY RIVER
TREMLEY
TREMLEY POINT
EAST RAHWAY
ARTHUR KILL
KILLS
FRESH KILLS
PORT READING
PHILADELPHIA AND READING
PENNSYLVANIA
LEHIGH
CENTRAL
HOFFMAN ISLAND
SWINBURNE ISLAND
LOWER BAY
STATEN ISLAND RAILROAD


BAYONNE TERMINAL
BAY
GOWANUS BAY
BUSH TERMINAL
BAY RIDGE
AN KULL
AMERICAN DOCK TERMINAL
THE NARROWS
GRAVESEND BAY
HOFFMAN ISLAND
SWINBURNE ISLAND
SHEEPSHEAD BAY
ROCKAWAY INLET
LOWER


EAST RAHWAY
CEN
AND
YORK
NEW
PHILADELPHIA AND READING
PORT READING
ARTHUR
PENNSYLVANIA
VALLEY RR
PERTH AMBOY
FRESH KILLS
STATEN ISLAND RAILROAD
GREAT KILLS
HOFFMAN ISLAND
SWINBURNE ISLAND
LOW
BA
RARITAN BAY